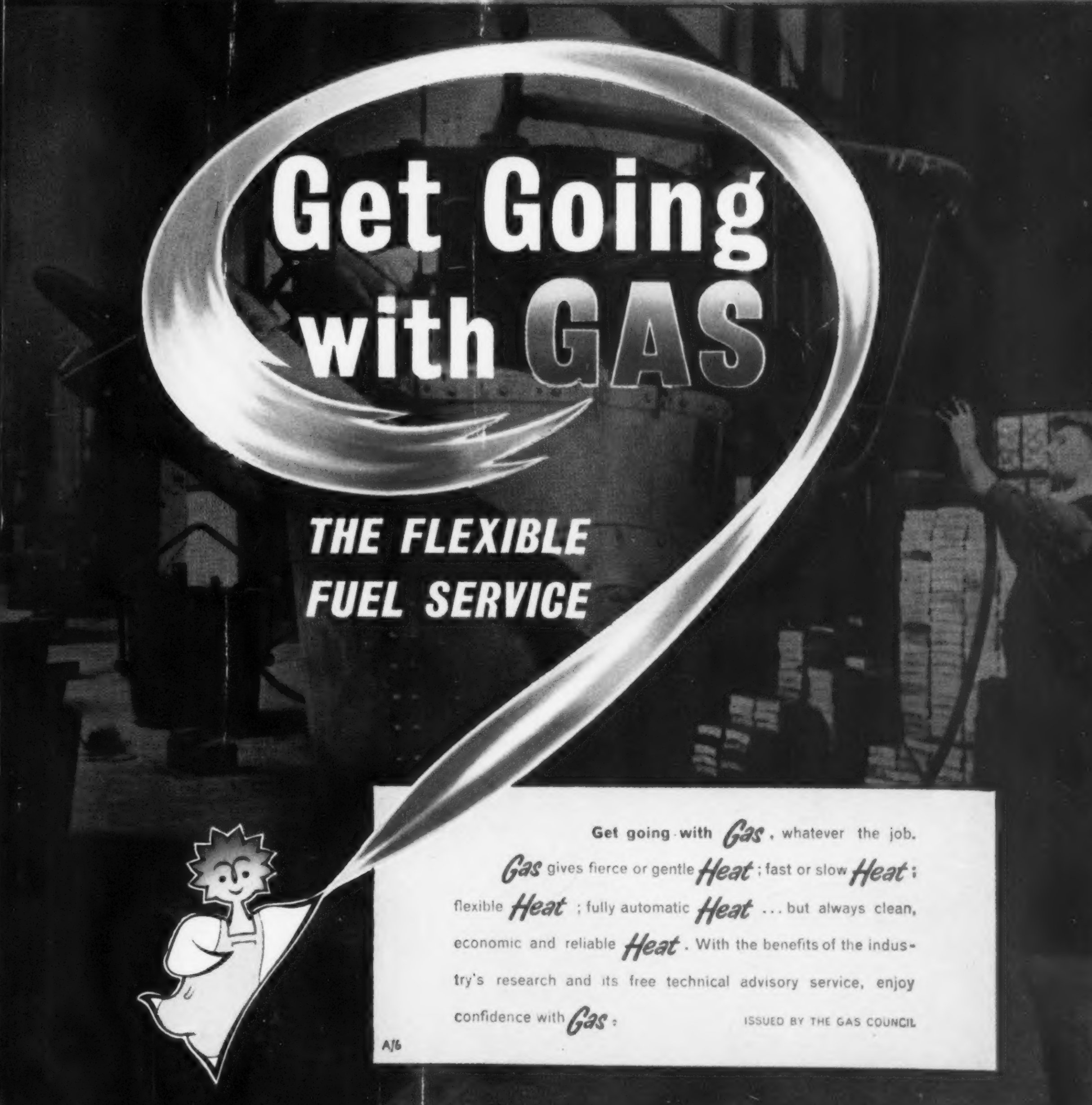
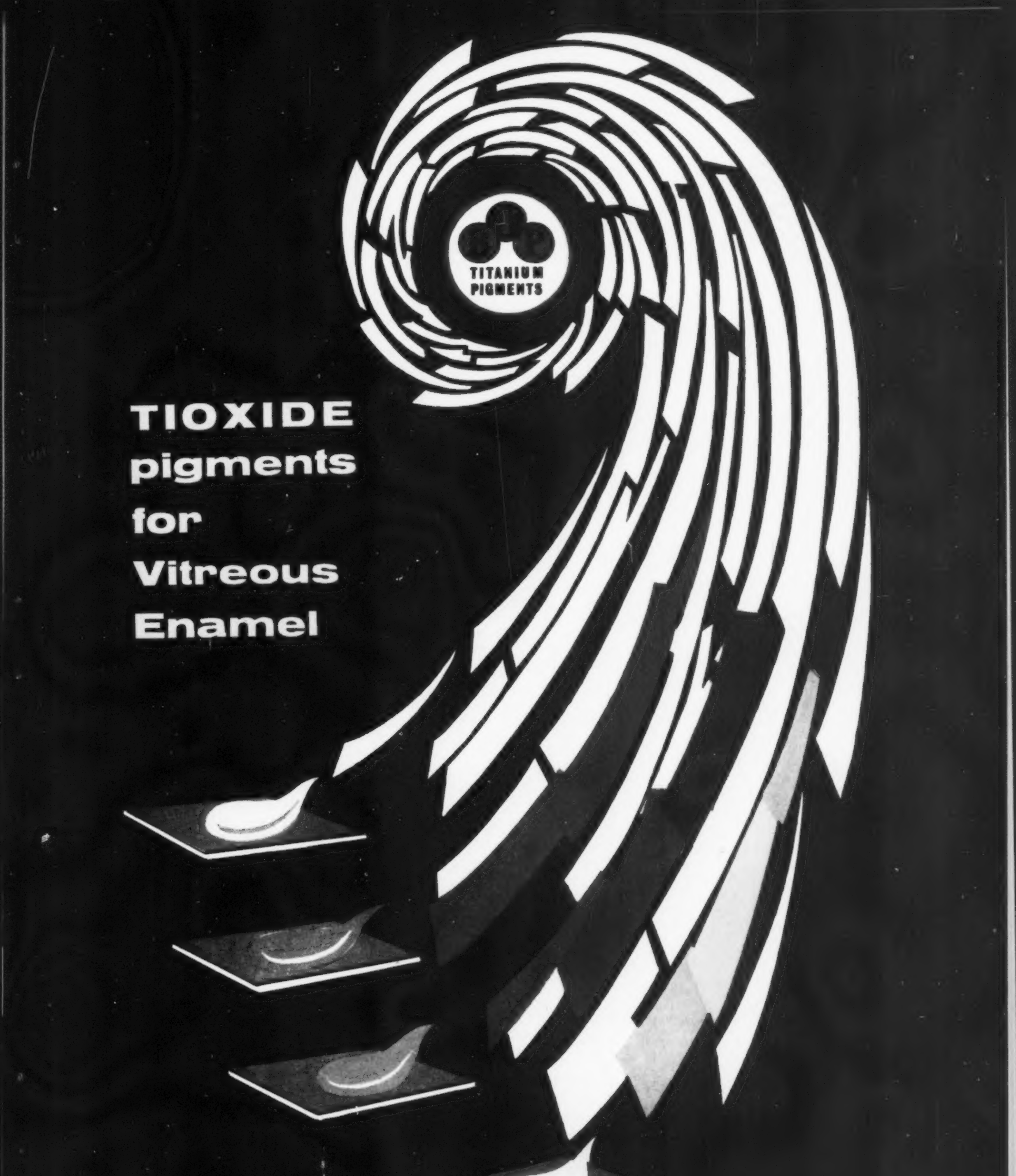
metal finishing

PAINT APPLICATION, ELECTRODEPOSITION, VITREOUS ENAMELLING,
GALVANIZING, METAL SPRAYING and all METAL FINISHING PROCESSES

Vol. 7 No. 79 (New Series) JULY, 1961




TITANIUM PIGMENTS
TIOXIDE
pigments
for
Vitreous
Enamel
British Titan Products Co Ltd
91-4A
10 STRATTON STREET LONDON W.1

What the eye doesn't see . . .

. . . is the superb finish inside. This internal finish is most important to the life of the 'Keymatic' and to its washing efficiency. It is true of all Hoover products that the things you cannot see are all finished with the same care as the outward features.

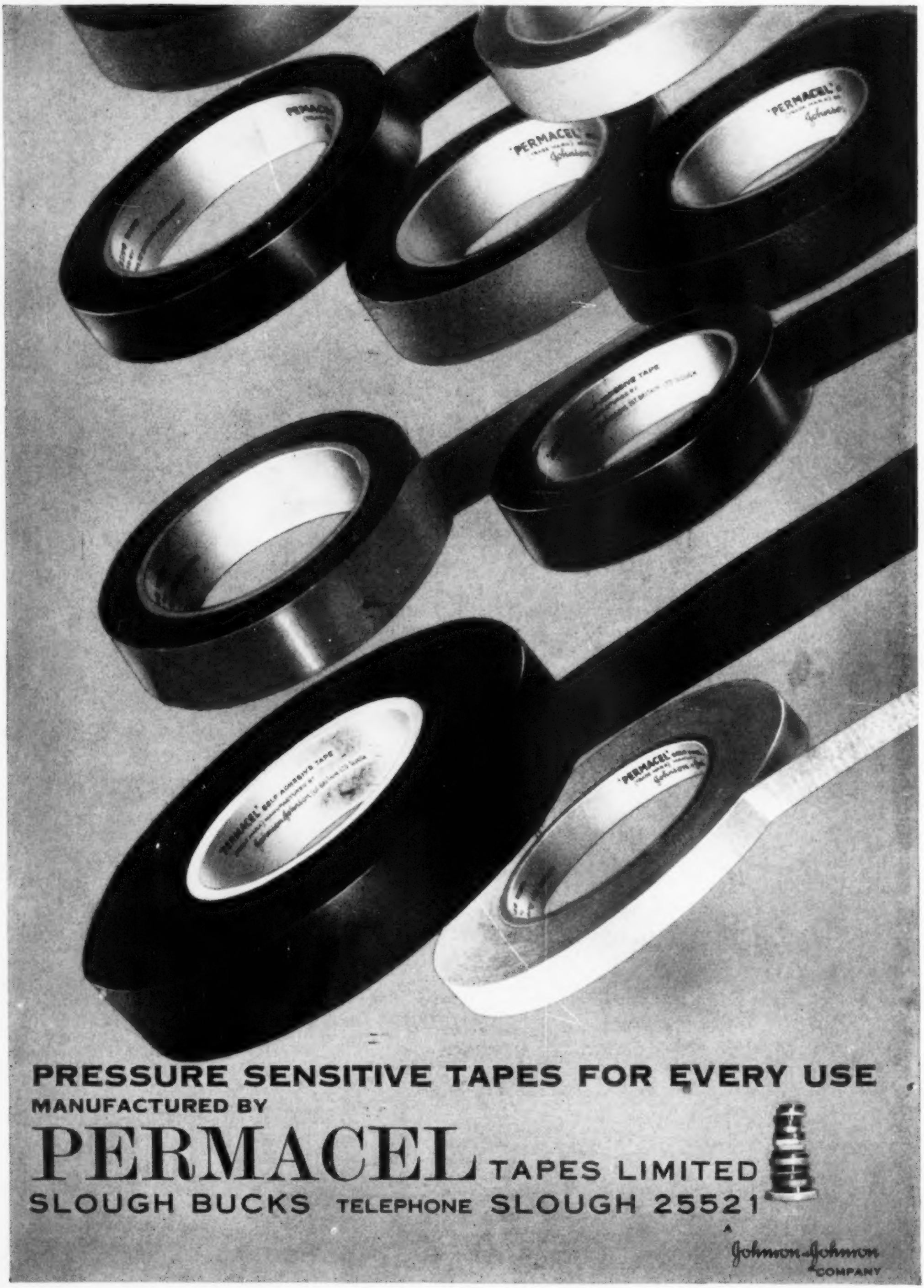
HOOVER  'KEYMATIC'

INCANDESCENT make the same claim for their products, so it is not surprising that the two companies should work together. Hoover selected INCANDESCENT fusing furnaces, drying ovens and the vitreous porcelain enamel for producing the 'Keymatic's' fine internal finish. Follow Hoover — select INCANDESCENT finishing equipment.

INCANDESCENT

COATINGS DIVISION. The Incandescent Heat Co. Ltd., Smethwick, England

10/19G/61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PERMACEL TAPES LIMITED
SLOUGH BUCKS TELEPHONE SLOUGH 25521
A
Johnson & Johnson
COMPANY


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These checks save cheques
Free checks of your finishing plant to ensure perfect results without rejects is just one of the benefits of the Aerograph-DeVilbiss Total Service that could save you cheques. This service provides—free—the seven pillars on which perfect finish rests.
1. Expert analysis of your finishing problem
2. Correct selection of equipment (standard or special design) to meet individual needs
3. Manufacture of the widest range of equipment
4. Prompt supply through our nation-wide organisation
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6. Training operators in the latest techniques
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Total Service is available even to the smallest user of spray equipment. So make a date with your Aerograph-DeVilbiss man and check how Total Service can save you cheques. Ring or write today.
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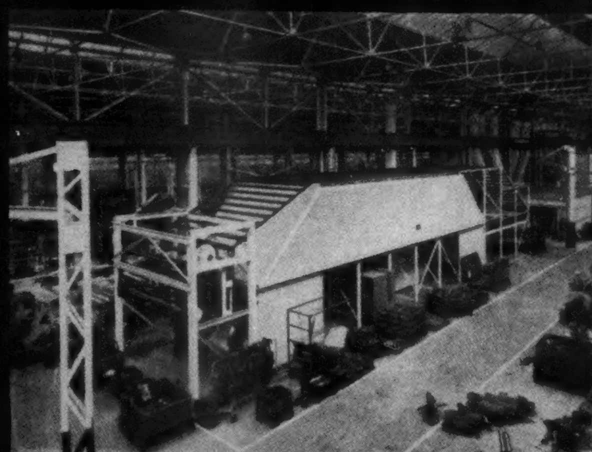
STORDY

CONTINUOUS PAINTING AND STOVING PLANT

Another excellent example of Stordy engineering in the design and building of plant for the pre-treatment, painting and stoving of metal parts.

The photograph shows a large gas fired air circulated 'A' type stoving oven for both hand dipped and sprayed work, covering a wide size range and gauge of parts. Conveyor width 9' 0" with a clear hanging depth of 5' 0".



STORDY ENGINEERING LIMITED

CUMBRIA HOUSE · GOLDTHORN HILL · WOLVERHAMPTON

SM/SE 6294

metal finishing journal

July, 1961 — AN INDUSTRIAL NEWSPAPERS PUBLICATION — Vol. 7, No. 79 (New Series)

Editor : EDWARD LLOYD, A.I.M., A.C.T.(Birm.) *Assistant Editor :* TREVOR EVANS
Southern Area Manager : E. COLLIS *Northern Area Manager :* G. P. ELLIOTT *Scottish Area Manager :* T. H. SMITH
Midlands Area Manager : E. J. SWEETING
Production Manager : R. J. LOVELL *Circulation Manager :* E. T. GRIFFITHS *Publisher :* H. J. DWYER

Official Organ of the

INSTITUTE OF VITREOUS ENAMELLERS

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J. NICHOLLS

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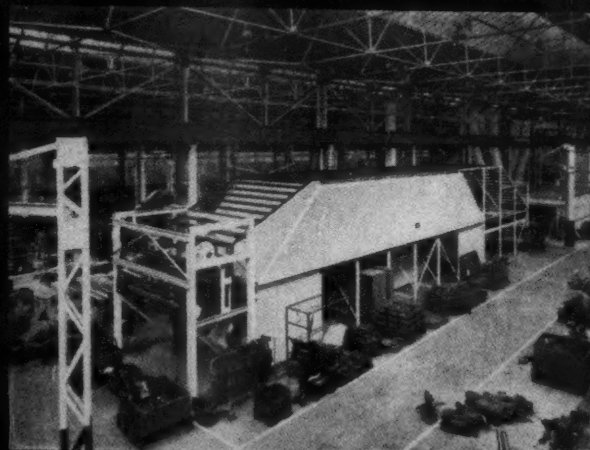

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Contents

IRREGULAR

PAGINATION

DRAWING THE CROWD

LAST month we ventured to voice on this page a mild expression of surprise that it had been found necessary to organize an exhibition with all its attendant expense and difficulties in order to provide the finishing industry with a meeting ground between the suppliers of equipment and materials and their customers, in spite of the fact that various trade and technical organizations have existed for a number of years which have as their main purpose the provision of such facilities. The reactions which this comment evoked have been as interesting as they are varied.

A small number of exhibitors at the Earls Court Show disagreed with our appraisal of the venture and said that they had derived little perceptible benefit from participating. Such views however, were very much in the minority and a very much larger number of exhibitors expressed themselves as having been particularly satisfied with the interest shown in their wares, and in many cases, with the volume of direct business done. This was generally attributed to the comparative novelty of the occasion and the length of time that had elapsed since any previous venture of the kind had been attempted. Many exhibitors produced the familiar plaint that they find exhibitions to be an expensive and time-consuming exercise in which they are compelled to participate because their competitors do. More enlightened and gratifyingly numerous were the exhibitors who claimed that the results of exhibiting had brought home to them the fact that some overhaul might be appropriate in their approach to sales and public relations.

What the exhibition apparently succeeded in doing was to present sufficient attraction to ensure the attendance of high level representatives of a very substantial proportion of the significant users of finishing plant and materials in this country, a proportion far greater than normally attends, for example, the annual Metal Finishing Conference. There are those who have attributed this to the very great publicity effort that was put behind the exhibition, which was on a scale certainly not approached by the Institute of Metal Finishing. On the other hand there can be few, if any, responsible people in the field of metal finishing who are not aware of the existence of the I.M.F. and familiar with its programme. The decision of such people to take part or otherwise in I.M.F. activities can only be taken on the grounds of the attractiveness or otherwise of the programme offered.

It is particularly noteworthy that of all the stands at the recent exhibition, those which consistently attracted the greatest amount of interest and attention were those devoted to the application of paint, and there was ample evidence that the problems of applying an adequate paint coating with speed, economy and a reasonable expectation of life, continue to exercise the minds of many people in industry. Having regard to this it is perhaps surprising that the specialist group within the I.M.F. which was set up nearly ten years ago to provide a specific platform for the discussion of problems of paint application has made such little progress to date in achieving size and technical status.

It might reasonably have been expected that the expansion in membership which the I.M.F., like all its kindred associations, is ardently seeking, would have been most readily found in the organic finishing field.

Talking Points

by "PLATELAYER"

TOPICAL COMMENT FROM THE MAIN LINES AND SIDE LINES OF METAL FINISHING

THERE'S NO PLACE LIKE WORK

DESPITE all efforts, the factory accident rate in this country stays high — so high, in fact, that some people in close touch with the problem wonder how genuine the figures for the industrial injury rate are. Clearly, if someone falls off a ladder in a factory, there is no doubt that this is an industrial injury. On the other hand, if a woman gets a skin rash through the unwise use of a detergent at home over the week-end, it is all too easy for her to convince herself that it started on Friday as a result of handling some chemical at work.

According to Mr. T. W. McCullough, H.M. Chief Inspector of Factories, the most serious source of accidents in industry today is due to manual lifting — 50,000 per annum—in spite of more and more mechanical aids. Again, it demands no great effort of thought transference to shift a slipped disc resulting from over-exuberant gardening on Sunday to the lifting of a drum on Monday. In each case, the financial advantages of the changed venue are considerable ; if you must have an accident it pays to have it at work, and consciously, or unconsciously, there will always be a tendency for some kinds of injuries to transfer themselves from the outside to the inside of the factory gate.

STANDARDIZATION GONE MAD

"THUS, in Eastern Europe systematic preparations are made to ensure that the industrial products of various countries are comprised of the same interchangeable elements regardless of the country of origin."

—*German Democratic Republic Review.*

The Review goes on to say that new apartment houses will be of three basic types only. There will be three kinds of taps — one for the kitchen sink, one for the wash-room and one for the bathroom, by contrast with France, for example, where no less than 1,134 different kinds of taps are available. Come to think of it, there is nothing really new about the system ; it has been used in the West for centuries in the construction of penitentiaries. No doubt the cities upon which these structures are to be inflicted will come to resemble them in due course.

If ever standardization reaches this kind of efficiency here, I shall be tempted to start an agitation for an Anti-Standards Institution. Of course, nothing can justify the existence of 1,134 kinds of tap ; on the other hand, for only three to be available is no better. One of the greatest failings of humanity is its inability to strike a happy medium.

ALL IS NOT CHROME THAT GLITTERS

I HAVE been taken to task by Mr. Caspar Brook of the Consumers' Association, publishers of "Which, ?" for my comment on the confusion which might arise as a result of their members being invited to criticize the "chrome" on their cars without having the term more closely defined. He says that the Association has a high regard for the intelligence of its members, who "can tell the difference between chromium and other finishes." Having seen experts frequently confused, I beg leave to doubt this ; but in any case, why not be precise and use the word "brightware," instead of "chrome"? This misuse of the latter word reminds me of the lady I heard tell her friend that she had a "G.E.C." hoover.

I look forward, however, to seeing the Association's report from which we shall no doubt be able to assess the relative merits of anodized aluminium "chrome" and aluminized plastic "chrome" as compared with high-chromium-iron "chrome," and even chromium plated "chrome"!

REJECTED WITH MUSIC

A NEW type of thickness gauge has just been developed which gives audible warning if the thickness of sprayed zinc or aluminium coating is below the specified level. An exploring head enables large areas to be checked and the alarm sounds if the coating is of inadequate thickness at any point. Not having yet heard the device in operation, I am wondering what kind of sound it emits. Does it put out a few bars of the theme tune from "The Thin Man," or does it play the "Colonel Bogey" march? In all probability, though, it just makes a rude noise!

NO SPANNER IN THE WORKS!

"FROM Mr. J. E. Dodds (Rolls-Royce Limited) came a complaint that, having introduced a new type of nut, no British firm can be found to supply the necessary spanners."

—*B.S.I. News.*

INSTITUTE OF VITREOUS ENAMELLERS

Annual Conference and "Confair"
Harrogate, May, 1961

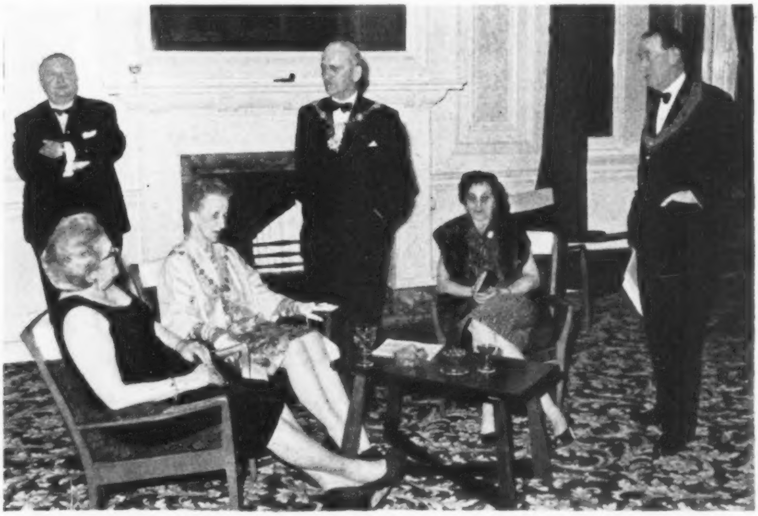
THIS year's Annual Conference of the Institute of Vitreous Enamellers, which was held at the Hotel Majestic, Harrogate, on the 24 - 26 of May, differed slightly in form from the majority of its predecessors. The main difference stemmed from the decision taken last year to divorce the Annual General Meeting of the Institute from the Conference and to hold it in association with a formal dinner in the Autumn as heretofore, while leaving the Conference free to be held on any convenient date in the Spring or early Summer.

The immediate result was that the Conference itself became a less formal affair and the 250 delegates and their ladies who were present were provided with excellent opportunities for getting together informally, which are always a valued feature of such meetings.

The proceedings of the Conference were initiated on the evening of Wednesday, May 24, when the Conference and its concurrent Exhibition were officially opened by Councillor Leonard Roberts, J.P., the Mayor of Harrogate. This brief ceremony was followed by a reception for all delegates and their ladies.

The following day was devoted to works visits when delegates had the opportunity of visiting the works of either British Titan Products Co. Ltd. at Billingham, or The General Electric Co. Ltd. at Mexborough. At each of these works the parties were made most cordially welcome and were most hospitably entertained, and both parties found the visits of exceptional technical interest. While the delegates were visiting the works the ladies were taken on a coach tour of the Yorkshire moors and dales, including visits to Bolton Abbey and Harewood House. In the evening dinner was taken to the accompaniment of an entertainment presented very effectively in the manner of a typical Edwardian Music Hall.

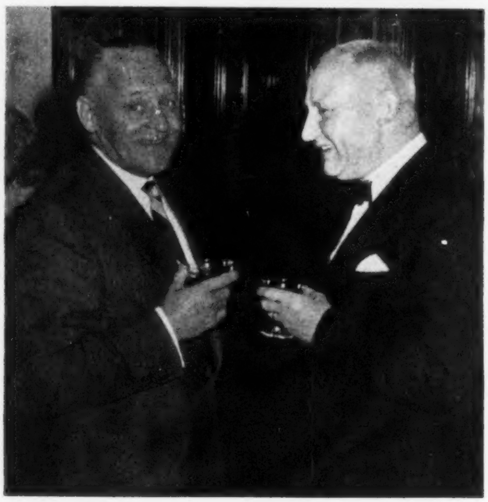
The whole of the next day was taken up with the presentation and discussion of the following papers.



The Mayor of Harrogate, Councillor Leonard Roberts, J.P., formally inaugurates the Conference assisted by the Mayoress, Mr. J. Nicholls, (Chairman of the Institute) and Mrs. Nicholls, Mr. J. W. Gardom, (Past-President of the Institute), and Mrs. Gardom.

(right) This group inspecting some of the equipment used in demonstrations during the paper on "Electroluminescent Enamels" includes: Dr. B. K. Nikewski (Main Enamel Manufacturing Co., Ltd.); Mr. J. Taylor (Laporte Titanium Ltd.) and Mr. J. W. G. Pedder (Stewart and Gray Ltd.) (Hon. Treasurer of the Institute).

(below) Mr. J. Graham (Hammond Lane Ironfounders Ltd.) and Mr. A. Biddulph (Bilston Enamel Co. Ltd.).



Interfacial Reactions — A Report by a Sub-Committee of the Technical Committee of the Institute.

Electroluminiscent Enamels by P. W. Ranby (Thorn Electrical Industries Ltd.).

Enamelling for Architectural Purposes by D. Mill (Escol Products Ltd.).

Conditions and Considerations of the Modern Weekly Wash by F. Pennock (Thomas Hedley and Co. Ltd.).

The Economics of Low Pressure Spraying by J. Muirhead (Aerograph DeVilbiss Co. Ltd.).

The Conference concluded on the final evening with a gala Dinner Dance, the enjoyment of which, particularly by the ladies, was greatly enhanced by the fact that the formal speeches and toasts which so frequently feature on such occasions, were absent.

The "Confair"

The "Confair," the exhibition held concurrently with the conference consisted of a total of thirteen stands, two of which (Stands 9 and 12) displayed publications of the Institute and *Industrial Newspapers (Fuel and Metallurgical) Ltd.* (publishers of METAL FINISHING JOURNAL), respectively. Among the Institute's publications, in addition to reprints of papers which have appeared in the "Bulletin," were "The Atlas of Enamel Defects," and Prof. A. E. Andrew's new edition of "Porcelain Enamels" which may be obtained through the institute.

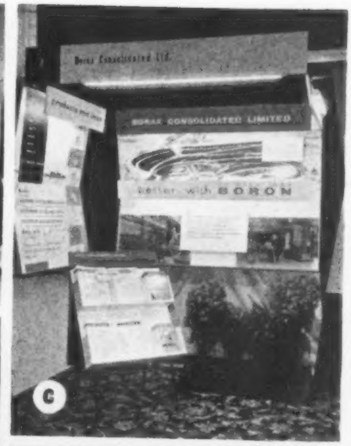
(Text continued in page 256. More photographs of Conference personalities are on pages 254 and 255)

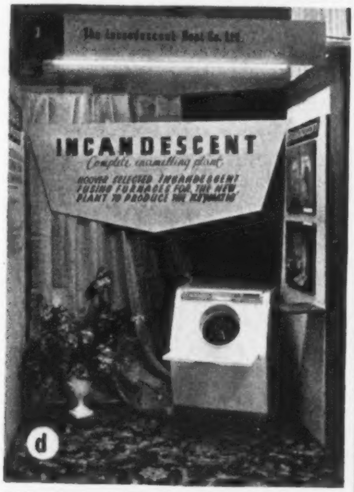
Some Confair Stands *(facing page)*

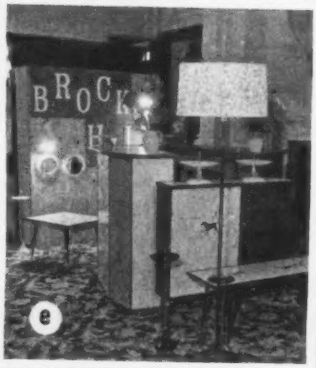
(a)—Metalectric Furnaces Ltd.
(b)—British Titan Products Ltd.
(c)—Borax Consolidated Ltd.
(d)—The Incandescent Heat Co., Ltd.
(e)—Brockhill Products Ltd.
(f)—Metal Porcelains Ltd.
(g)—The Aerograph-DeVilbiss Co., Ltd.
(h)—Borax and Chemicals Ltd.
(i)—Controlled Heat and Air Ltd.
(j)—Laporte Titanium Ltd.


Metalectric Furnaces Ltd.
ELECTRIC FURNACES
Continuous
vitreous enamelling
a


VITREOUS ENAMEL
Titan Products Co Ltd
b

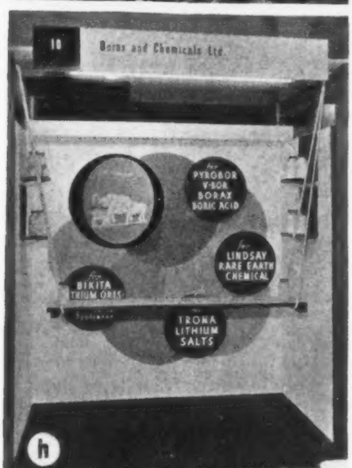

BORAX CONSOLIDATED LIMITED
better with BORON
c


The Incandescent Heat Co. Ltd.
INCANDESCENT
Complete enamelling plant
d

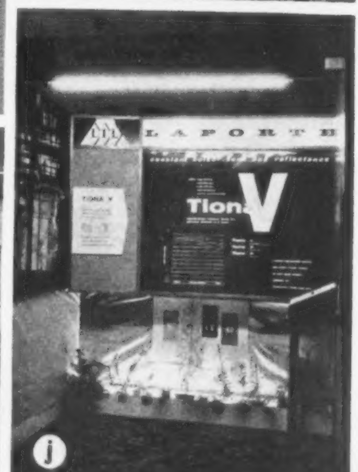

BROCK
e


Metal Porcelains Ltd.
f


The Aerograph - DeVilbiss Co. Ltd.
SPACE AGE SPRAY FINISHING EQUIPMENT by AEROGRAPH DEVILBISS
g


10
Borax and Chemicals Ltd.
PYROBOR V-BOR BORAX BORIC ACID
LINDSAY RARE EARTH CHEMICAL
TRONA LITHIUM SALTS
h


Controlled Heat & Air Ltd.
CHAL
For SPRAYING and DRYING PLANTS
DUST COLLECTION and FUME REMOVAL
consult CONTROLLED HEAT & AIR LTD
i


LAPORTE
Tiona V
j

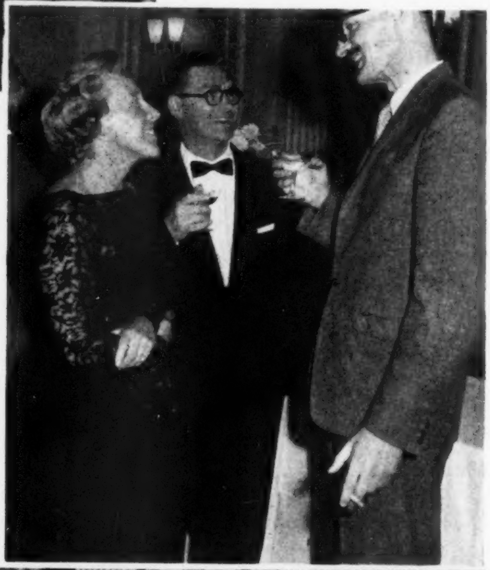
(left) Mr. F. Pennock (*Thomas Hedley and Co., Ltd.*); Mr. S. E. A. Ryder (*Stoves Ltd.*) and Mr. J. K. Hossack (*Ferro Enamels Ltd.*)

•

(below) Mr. and Mrs. A. W. Murdoch (*Ferro Enamels Ltd.*); and Mr. W. Kendall-Tobias (*Blythe Colour Works Ltd.*)

•

(below, left) Mr. A. H. Symonds (*Ferro Enamels Ltd.*); Mr. E. J. Heeley (*I.C.I. Ltd. (Dyestuffs Division)*); and Mr. Wilson and Mr. Jones (*Johnson Matthey and Co., Ltd.*).



(right) Mr. J. C. Leith (*Smith and Wellstood Ltd.*); Mr. S. W. Barkhouse (*G.E.C. Ltd.*); Mr. P. Duff (*Escol Products Ltd.*); Mr. T. Issitt (*Ferro Enamels Ltd.*); and Mr. C. Vickers (*Ferro Enamels Ltd.*).

(right) Mr. T. R. Goodman (W. G. Ball Ltd.); Mr. K. M. Shires (Johnson Matthey and Co., Ltd.); Mr. A. J. Gregory and Mr. A. W. Ayres (British Titan Products Co., Ltd.).

•

(below) Mr. L. E. Turner (Balbardie Ltd.); Mr. G. Blow (Borax Consolidated Ltd.) and Mr. T. Gray (Lafarge Aluminous Cement Ltd.).

(above) Mr. M. F. Ball and Mr. J. M. Schofield (Borax Consolidated Ltd.).

•

(left) Mr. P. H. Mason and Mr. A. G. F. Cowles (Vitreous Enamellers (Slough) Ltd.); Mr. P. Rogers (Wilsons and Mathiesons Ltd.) and Mr. W. G. Ball (W. G. Ball Ltd.).

Letter to the Editor

• "Chrome" on Motor Cars

SIR,

I read with interest your note entitled "Pitfall" in the May issue of METAL FINISHING JOURNAL.

I can set your fears at rest. We were less concerned with the actual metal finish on cars' brightware than with establishing sources of car owners' irritation with their cars. Past experience of questionnaires addressed by us to members of CA has taught us to have a high regard for their intelligence and common sense as well as general knowledge.

We expect, therefore, that they can tell the difference between chromium and other finishes.

I must say I am a little astonished that METAL FINISHING JOURNAL should be so concerned about what car owners feel about the finish of various car parts, that it should criticize a survey the results of which have as yet to be analyzed. Might it not have been better if you had awaited the results of the survey before trying to cast doubt upon it?

Yours etc.,

CASPAR BROOK.

Director and Secretary,
Consumers' Association Ltd.
London, W.C.2.

"Platelayer" makes a further comment on page 250.—Ed.

Institute of Vitreous Enamellers

(*Continued from page* 252)

In addition to this Journal, Industrial Newspapers displayed SHEET METAL INDUSTRIES and FOUNDRY TRADE JOURNAL, both of which have close contact with the enamelling industry.

British Titan Products Ltd. (Stand No. 1) showed the advantages of titanium-oxide-based enamels; for example excellent opacity, resistance to thermal and mechanical shock due to thinner coats, and acid resistance etc.

Stand No. 2 was occupied by *Metal Porcelains Ltd.* who manufacture a complete range of vitreous-enamelling frits, and who are currently investigating the improvement of chip resistance by the development of one-coat low-temperature fusing enamels for sheet steel and the adaption of high-opacity thin-application enamels for use with cast iron. This company are members of the Incandescent Heat Group of Companies which also occupied three other stands. *The Incandescent Heat Co. Ltd.* (Stand No. 3) featured their vitreous enamelling furnaces and "Jetube" recirculating tube heaters; *Controlled Heat and Air Ltd.* (Stand No. 4) supply spray booths and drying ovens, automatic spraying plants, and dust collectors, etc., while *Metalectric Furnaces Ltd.* (Stand No. 5) showed the advantages of electric fusing and photographs illustrated typical batch and continuous installations.

The Aerograph-DeVilbiss Co. Ltd. showed on Stand No. 6 a range of spray guns. The company have developed a vitreous-enamel spraying process which uses a very low air pressure, giving a saving in material due to reduced overspray. Also shown was an air transformer fitted with centrifugal oil and moisture separator and a special composition filter.

The vitreous-enamelled mural (illustrated in the last issue of M.F.J., page 237) exhibited by *Ferro Enamels Ltd.* (Stand No. 8) fulfilled the dual purpose of illustrating the wide range of colours available from the company and also demonstrated the versatility of the medium. Ferro colours coupled with their wide range of enamels are available to every user of vitreous enamel in whatever field of application.

The development of fresh boron products and research into new applications are among the main activities of *Borax Consolidated Ltd.* and its associated companies (Stand No. 7). The stand also featured the more prominent of boron's varied contributions to modern industry etc., together with the products available from the company.

Borax and Chemicals Ltd. (Stand No. 10) also exhibited a range of boron products, including borax and boric acid, lithium ores and caesium oxide. Caesium is the most reactive of the alkali metals and may prove to be another valuable raw material for enamel manufacture.

Titanium oxide has become established as an important raw material in the vitreous-enamelling industry particularly for use in acid-resisting and super-opaque enamels, and on Stand No. 11, *Laporte Titanium Ltd.*, featured the properties of their various grades of titanium oxide.

Brockhill Products Ltd. (Stand No. 13) showed a collection of entirely new designs in decorative enamel furniture. Some of the designs were in delicate pastels, others in more vivid shades. A variety of textures is possible and the display showed that embossing or stamping of the surfaces makes for prominent attractive designs. It was apparent that these combinations of metal and glass produce pleasing, colourful and serviceable furniture.

INTERFACIAL • • REACTIONS

AN I.V.E. SUB-COMMITTE REPORT

The Sub-Committee : S. E. A. Ryder (Chairman), A. Biddulph, H. H. Johnson, N. S. C. Millar, Dr. B. K. Niklewski

This paper deals with a number of experiments carried out on specially produced titanium steel in order to assess the possibility of its use for direct-application cover-coat enamelling. Three manufacturers co-operated in carrying out the tests, each using a different frit but similar processing methods. The results of these tests are given, the future use of titanium steel is discussed and suggestions are made as to the direction of future research.

THE Interfacial Reactions Sub-Committee was set up in December 1958. About this time the possibility arose of obtaining a fair-sized supply of British-made titanium steel and it was agreed that the Interfacial Reactions Sub-Committee should handle this material and carry out with it trials for direct application of cover coat.

Titanium steel has been in use for direct application in the U.S.A. for some years, although so far as is known, only one organization uses it in regular production and even then only for a limited number of components of a domestic appliance. The extra cost of titanium steel in America is approximately one-third more than the equivalent grade of enamelling iron and this may have been considered prohibitive by American enamellers generally. However, no reliable details of American results with the material are available. Several members have enamelled small sample pieces of American titanium steel and one member of the Institute has reported trials carried out on a quantity of British-made titanium steel, but in view of the general interest in direct application of cover coat to steel it was considered that controlled trials on an appreciable quantity of the material would be of value.

Titanium steel is manufactured in Britain, usually in an electric furnace, as an alloy steel, but the alloy-steel makers do not possess the rolling facilities required to produce the type of sheet called for by the enamelling industry. The sheet titanium steel was made available by the generosity of two members of the steel industry who went to considerable trouble to meet our requirements. The steel was made by the Clyde Alloy Steel Co. Ltd., a branch of Colvilles Ltd., who supplied specially prepared slabs, at a special price, to John Summers and Sons Ltd., who very generously undertook the rolling to sheet, free of charge, at considerable trouble to themselves. The thanks of the Institute are due to these two firms for their very willing co-operation.

The object of adding titanium to steel is to neutralize the effects of nitrogen and to "lock up" the carbon present as the very stable titanium carbide. Titanium has a great affinity for carbon, so that, providing sufficient titanium is added, the only carbide present will be the titanium carbide and the iron will be completely ferritic. In order to achieve this condition it is generally accepted that the titanium content should be at least 5 times the carbon content.

The slabs were produced by 5 casts and the analyses were as shown in Table I.

Table I.

	Cast No. 1	Cast No. 2	Cast No. 3	Cast No. 4	Cast No. 5
Carbon	0.055	0.065	0.08	0.06	0.05
Silicon	0.29	0.24	0.35	0.15	0.27
Sulphur	0.039	0.026	0.030	0.032	0.025
Phosphorus	0.016	0.015	0.020	0.01	0.020
Manganese	0.42	0.25	0.39	0.32	0.33
Titanium	0.28	0.39	0.55	0.30	0.25

Approximately 27 tons of slabs were delivered for rolling. It was agreed that the resulting sheets should be divided equally between the three appliance manufacturers represented on the Sub-Committee, and they, in order to simplify the rolling, agreed on a common sheet width. No particular difficulty was experienced in rolling the material, but some was experienced in annealing the bundles of sheets after rolling. After annealing, some sheets were found to have a dark graphite deposit on the surface, usually near the edges and extending inwards a few inches, but sometimes extending towards the centre of the sheet. Bundles of titanium steel sheets were annealed together with bundles of ordinary steel sheet, in the same furnace load and the ordinary steel came out quite clean, while the titanium steel was stained. It appeared that the titanium steel was reacting

with the atmosphere of the furnace, causing breakdown of hydrocarbons to produce the graphitic deposit.

The limited amount of titanium steel available, and the necessity to process it with ordinary steel, did not allow for extensive experiments on a production scale being carried out, but it is felt that the trouble could be overcome by modification of the furnace atmosphere, for example by reducing the proportion of methane, or by reducing the CO/CO_2 ratio.

The black deposit was found to be virtually impossible to remove. Scouring or pickling had little effect on it. Heavy scaling followed by pickling did not entirely remove it. Enamelling over a heavily stained area resulted in a blistered surface and poor adhesion. Enamel applied over a lightly stained area was not affected.

Unfortunately, one of the three participants in the trials inadvertantly received the bulk of the stained material and his results are effected accordingly.

Physical tests were carried out on a number of samples and the mechanical properties were as shown in Table II.

Table II.

Plant	Gauge	Olsen	Rockwell	Yield point (lb. per sq. in.)	Ultimate tensile strength (lb. per sq. in.)	Elongation (per cent)	Yield point elongation
A	0.037	380	70	36,300	60,500	22	NIL
	0.038	395	64	42,400	58,000	21	NIL
	0.037	365	64	34,000	59,000	21	NIL
	0.035	380	65	35,000	59,800	21	NIL
B	0.034	390	69	42,400	58,000	21	2.0
	0.039	400	64	32,200	60,000	22	NIL
C	0.036	350	70	50,600	61,500	19	3.6
	0.038	360	70	43,700	55,700	21	2.0

John Summers had warned the three manufacturers that the drawing qualities of the titanium steel would not be very high, so that difficult draws were not attempted, but the straight-forward simple drawing involved in forming cooker-door panels and outer sides gave no trouble.

Each of the three manufacturers, after receiving his supply, carried out preliminary trials to determine the best procedure. Each reported promising results and it was agreed to proceed to enamel the bulk of the material.

The metal pre-treatment carried out by each manufacturer was as indicated in Table III.

Table III.

Process	Plant A	Plant B	Plant C
Grease burning	No.	No.	No.
Vap. Deg.	x	x	x
Alk. Cleaner	x	x	x
Type of Acid	HCl.	HCl.	Sulphuric
Temp. of Acid	Room Temp.	90°F.	165-160°F.
Nickel Flash Temp.	185°F.	165°F.	170-175°F.
„ „ Time	5 min.	15 min.	8½ min.
„ Deposition (gm. per sq ft.)	0.05-0.08	0.08-0.09	0.08
Neutralizer	Borax/Soda	Na_2CO_3	Soda Ash (after ⅛% cream of tartar rinse)

Enamel

Each manufacturer used a different frit, although in each case it was a high-opacity titanium frit, acid resistant and of a fluid type, firing at approximately 820°C.

The enamel was ground to the same fineness as used for normal production over ground coat, using clay for suspension and standard electrolytes, but avoiding the use of any chloride in the mill addition.

Application was by spray and a fired thickness of 0.005 in. was aimed at.

A standard form was agreed upon for reporting the results. Normal production methods of inspection were used, and since the manufacturers concerned normally compete in a common field, it may be assumed that the standard of inspection would be reasonably equal.

When reporting, each defect was counted and since some panels would exhibit more than one type of defect, the totals of acceptable pieces plus the number of defects total more than the number of panels processed.

The report sheets do not contain results of adhesion tests, but many were carried out by each manufacturer and adhesion as indicated by bend

Table IV.

Summary of Enamelling Results.

	Plant A	Plant B	Plant C
Number processed	4174	3503	228
Passed in 1st Coat	2946	2787	130
Sent for 2nd Coat	1189	727	94
De-enamel	19	44	4
Scrap	20	*23	
Bad Spraying	29	167	13
Marking	23	97	16
Blistering	649	332	64
Black Specks	487	249	10
Stain			3
Faulty Iron			1
Handling			
Passed in 2nd Coat	872	582	67
De-enamel	301	212	5
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Marking		31	11
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Stain			
Faulty Iron			
Handling			
Sent for 3rd Coat			12
Passed			7

* Rolling lines in metal.

tests and impact tests was uniformly very satisfactory and it can be stated with confidence that excellent adhesion of cover coat directly applied to titanium steel sheet can be relied upon if the necessary processing care is exercised.

The processing results were as shown in Table IV.

As already mentioned, the sheets received by manufacturer C were badly affected by the black deposit, a large proportion of the sheets received by him being unusable.

It is seen that the proportion of good pieces obtained in one coat was in the region of 75 per cent which can be considered quite good in view of the lack of experience with the material. The pieces which were still unsatisfactory after re-coating were de-enamelled and it was found they could be re-processed satisfactorily.

From the results of these trials it can be said that a good quality titanium steel sheet can be enamelled with cover coat direct to the metal with good results. Whether, in view of the extra cost of material and of the additional control which is essential, it would be economical to use titanium steel, will vary from component to component and could only be answered by each individual manufacturer from his close knowledge of his own products. In any case, it would almost certainly only be worthwhile to use the special material on a limited number of pieces on a multi-part appliance, such as a cooker.

The question will naturally be asked, what is the future position regarding titanium steel for direct-process enamelling? The possibilities of obtaining regular supplies from the British Steel Industry appear to be not very good. As already mentioned, the titanium steel is only produced by special alloy-steel producers in electric furnaces which are very much smaller than the open-hearth furnaces of the well known sheet steel producers. They normally produce billets for rolling in their own mills and their steel making and rolling plant are so integrated and balanced that if they supplied billets to an outside rolling mill, their own rolling plant would go short. It would therefore only be during slack periods that titanium steel for enamelling sheet could be produced.

As regards cost, in the case of this experimental batch, the cost per ton of the billets alone, before rolling, was approximately equal to the cost per ton of deep drawing enamelling grade finished sheets. The cost of rolling, involving re-heating, rolling, annealing, inspection, loss in cropping, etc., would obviously be considerable, so that the finished sheets would cost appreciably more than equivalent enamelling grade sheets. It must be borne in mind that the cost of this trial quantity cannot be taken as a guide to the likely cost if appreciable quantities were in regular production for the enamelling industry. Under such conditions it would be reasonable to expect some reduction in cost, but a true assessment is very difficult. As already mentioned, this trial quantity was produced in an electric furnace, but if sufficiently large regular quantities were envisaged, no doubt attempts would be made to produce the titanium steel in open-hearth furnaces, which would appreciably reduce cost. Such attempts have been made in the past, but the demand has not justified pursuing very costly experimental work. Also further experimental work would be required in connection with annealing of the sheets. It can thus be appreciated that cost of the material at present is extremely speculative.

In spite of the high cost involved, one of the three manufacturers considered it would be worthwhile using the titanium steel with direct cover coat, for certain components, and would probably do so if the materials were available. The other two, although well pleased with the trials, felt that the high extra cost would not be justified. The Committee as a whole, including the three manufacturers, felt that such progress was being made in other directions in applying cover coat direct to ordinary enamelling grade steel and to de-carburised steel that the interest in titanium steel is less than was formerly the case. It is understood that the one organization in the U.S. known to have used titanium steel in regular production with direct-applied cover coat had now stopped using the material.

New annealing processes developed in the U.S. allow the carbon content of sheet steel to be reduced to a very low figure. These processes, which almost completely remove the carbon, are very much cheaper than locking-up the carbon by adding titanium and in fact de-carburized material is available in the U.S. at very little higher price than guaranteed enamelling grade, but this must not be taken as indicating that if de-carburized steel is produced in this country it would be available at approximately the same price as English enamelling grade sheets. In America, sheet iron for enamelling is made specially for this purpose and is much lower in carbon and metalloids than rimming steel and carries a high premium as compared with the latter material. If, therefore, the de-carburized sheet is produced from rimming steel then it is understandable that it can be produced at the same cost as American enamelling grade iron. In this country enamelling grade sheet is rimming steel, the comparatively small premium charged being to cover cost of more exacting steel making specification and the cost of special inspection and cleaning of billets, extra cropping and special inspection of the sheets, but may not cover cost of the de-carburizing. There is no doubt, however, that de-carburizing sheet, if

(*Continued in page* 260)

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(*Continued in page* 260)

Interfacial Reactions

(*Continued from page* 259)

produced in this country, would be much cheaper than titanium steel. It is expected that this virtually carbon-free steel will give results with directly-applied cover coat comparable with those obtained with titanium steel without the drawback of prohibitive metal cost. The chances of very low carbon steel being manufactured in this country are not known at present, but it is hoped that at least one of the large suppliers of sheet steel for vitreous enamelling will be sufficiently enterprising to instal the necessary plant to produce similar or equivalent material to that now available to American manufacturers.

This Committee was set up as the " Interfacial Re-actions Sub Committee " and although no definite terms of reference were laid down, it was no doubt in the minds of the Technical Committee members that the Sub-Committee would investigate the chemistry, physics, and mechanics of adhesion of enamel to steel.

While a great volume of research work has been carried out on the adhesion of Co- and Ni-bearing ground coats to steel, comparatively little has been published relating to the application of light-coloured cover coats direct to steel and an investigation in this field would be very worthwhile.

The Sub-Committee has given much thought to this field, but respectfully suggest to the Technical Committee that such an investigation is a subject for a laboratory research programme involving such research tools as microscopy, spectrometry, X-ray analysis, etc. not generally available to the ordinary enameller or frit supplier. A Sub-Committee could not carry out such work, they could only steer and advise a laboratory team.

A considerable amount of development work is being done by enamellers and frit suppliers in relation to the direct application of cover coats, but the Sub-Committee felt it is at such a stage that it would be unfair to expect any company to make the results of this work common property, and the Sub-Committee suggest, therefore, that this report on the titanium steel trials should complete its work, at least for the time being.

NEW ELECTROMACHINING PROCESS

THE electrochemical machining process initially developed by the General Electric Company in the U.S.A. will be available for commercial use from the Hanson-Van Winkle-Munning Company under G.E. License. The new process is applicable to all metals and will find particular use in machining the modern alloys used in the space and nuclear programmes. The process permits stress-free machining of complex contours in any metal, including the refractory alloys, in a single operation, and also makes it possible to hold extremely close tolerances. Electrochemical machining makes significant savings in metal removal operations possible at a relatively low capital investment cost.

Gilding the Bluebell

"Stepney" the locomotive built in 1875 *and the oldest engine on the "Bluebell Line" in Sussex, has been restored to its original livery, light tan and crimson being the main colours. Paints were supplied by Atlas Preservative Co. Ltd., Erith, makers of Atlas industrial paints, and the repainting scheme was initiated by the company's advertising manager, Mr. E. J. Penston, seen here talking to the driver, Mr. Jack Owen (grocer, of Three Bridges).*

The Planning and Construction of INDUSTRIAL PAINT SHOPS 2

B. VAN DER BRUGGEN

(*Concluded from page 232, June issue*)

OPERATING SAFETY

AS the industrial paint shop usually handles highly inflammable materials or material involving a high fire risk, the influence of requirements imposed for operating safety and the corresponding regulations are factors of paramount importance. Both new buildings with their working equipment and also conversions or extensions of existing paint shops, as is known, are mainly assessed on the basis of recommendations or inspection surveys of work hazards through fire, accident and industrial health, and, as far as concerns the premium for fire insurance, are classified accordingly.

This assessment and classification, also important for the design of the structure may be very different and, in regard to fire risk, may vary between a minor fire risk and a danger of explosion. As far as possible, therefore, it should always be planned in the preliminary stages and not taken into consideration at a later date. Otherwise, subsequent structural alterations as, for instance, fire-protection walls, or other safety provisions required for the installation may seriously affect the building costs and also the efficient production flow. According to the applicable regulations in force and which vary from one country to another, on the one hand, questions of equipment and material, such as type of plant, method of working, installation, connections, etc., and the paint used, their nature, quantity, composition, etc., and, on the other hand, also the working conditions, which in each case will differ, such as form of building, position, surroundings, and communications, type of work handled, its inflammability, quantity, storage, etc., will be considered.

Estimation of the possible risks and also determination of the safety precautions are largely based, on the one hand, on the requirements of the regulations, which mainly take into account considerations easily understood, and restricted to the paint shop and, on the other hand, on factors varying from one plant to another, the assessment of which is largely a question of judgment. Some necessary adaptation of appropriate measures may well be necessary and is therefore undertaken as a rule not merely on the basis of particular paragraphs, but only after comprehensive assessment of all the factors, and a reasonable appreciation of the regulations. It is clear, however, that where structural solutions or conditions leave anything to be desired, a more exacting standard must be applied, and additional or modified safety precautions must be required, in which connection the so-called influencing or environmental factors will frequently be determinative for the interpretation of the regulations, which will be considered in the following section.

First, however, the more important safety requirements will be set out which are, more or less, generally valid. This is not intended as a complete review, and details in regard to the number, scope

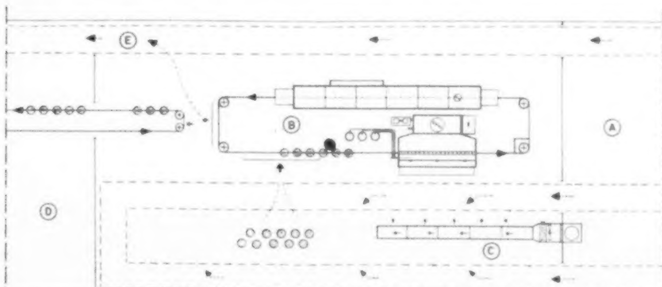

Fig. 23.—Layout of a paint shop for steel furniture. (A) Delivery from fabrication line ; (B) Stock-piling areas ; (C) Conveyor to paint shop ; (D) Spraying line with stoving tunnel ; (E) Making good and rubbing down ; (F) Assembly of painted components ; (G) Conveyor to shipping line (Layout plan by author).

and provisions of the official regulations applicable are not given.

Basically, the following measures contributing to safety require to be considered :

Buildings and walls. Constructed of incombustible material (steel structures, masonry or brickwork, concrete).

Floors. Incombustible, sparkproof and, as far as possible, seamless covering.

Doors. At least two doors or an emergency exit for each enclosed space or room ; doors made of fireproof material, opening outwards.

Windows. Incombustible, non-plastic structures, opening outwards if they are to be used as emergency exists.

Heating arrangements For space heating and pipes to the equipment, insulated pipes, exposed heating surfaces screened against overhanging fabrics or dust accumulation with surface temperatures not exceeding 80°C.

Equipment materials. Incombustible, preferably sheet steel, fireproof insulation (*e.g.* bricks, glass fibre).

Earthing of equipment. In each case, depending on the size and structural assembly (intermediate insulation) attached by drilling or welding ; where necessary, laid down in sections and by deep boring (soil conditions — underground water table).

Paint-spraying equipment. Manually operated equipment must be free from wood, woodwool or paper filters with adequate suction power, efficient airstream, washing and accessible paint draining point.

Paint-drying equipment. Explosion-proof construction ; ventilation to satisfy the requirements of the regulations in regard to maximum solvent concentrations, calculated from the drying space used, the volume of paint involved per unit time with maximum conveyor feed.

Flow-coating equipment. Casings, pipes, pumps, fans, etc. of incombustible material, separately earthed against static and frictional electricity, flooding zone mechanically washable, paint containers connected only by closable pipes with the internal space of the installation, ventilation adjustable together with paint supply.

Space ventilation ducts. Incombustible material, smooth pipe linings, (dust accumulation), accessible cleaning ports, adequately distributed air outlets, (draughtless).

Air extraction pipes. Incombustible material, adequate cross-section and clearance between pipe walls and fan blades, preferably straight-line flow, dismountable in sections — sluice valves cut out to about 1/5.

Cleansing and degreasing equipment. Preferably completely enclosed and using aqueous solutions, with adequate vapour extraction and mechanical feed and removal of the work-pieces.

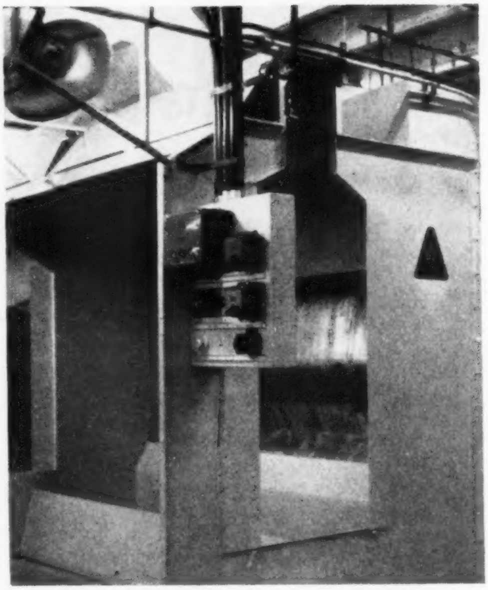

Fig. 24.—Switching station of a spray installation, controlling automatic units, conveyors, etc.

Switch and control gear. Switches lower than 2 metres above floor level, on paint-applying equipment, to be explosion-proof ; but in low-voltage circuits on the walls of large paint cubicles and on equipment handling aqueous solutions, standard constructions can be used ; modern metering and control equipment ; and, in other respects, according to the grading of the particular space (fire-risk rating), in accordance with the regulations in force.

Space and equipment illumination. On paint-applying equipment and in paint stores, explosion-proof; near such equipment and less than 2 metres above floor, also explosion-proof, unless located in a current of fresh air ; wall plugs locked ; overhead space lighting of standard pattern if within ventilated spaces of sufficient size.

Paint storage. According to demand (type of equipment), large quantities in separate, fireproof store ; not more than one week's supply to be kept in painting shop (excepting fitted, closed containers on equipment itself).

Paint feed on equipment. Preferably from pressure tanks with hose or pipe connections to using point. Distribution circuits for serving a number of points, small quantities in closed metal containers.

Fire-extinguishing equipment. Two or three, hand fire extinguishers for equipment of average size (foam, dry powder, CO_2, gas, depending on type of paint and form of application) ; on special

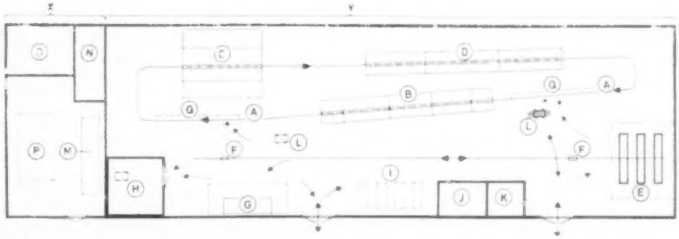

Fig. 25.—Layout of a paint shop for electrical switchgear : (A) Overhead conveyor ; (B) Pressure blast tunnel (surface cleaning, pretreatment) ; (C) Continuous paint spraying line ; (D) Enamel stoving tunnel ; (E) Rust removal installation ; (F) Electric hoist ; (G) Paint spraying station for large components ; (H) Drying chamber for large components ; (I) Filling and rubbing-down stations ; (J) Paint preparation (equipment store) ; (K) Foreman's office ; (L) Carrier trucks ; (M) Air compressors ; (N) Fresh-air plant ; (Q) Waste-water cleansing tank ; (P) Hot-water boiler plant ; (Q) Conveyor control stations ; (Y) Production line ; X) auxiliary lines. (Layout plan by author).

equipments and in wood-painting shops, also built-in mist or sprinkler extinguishers with automatic release.

Warning boards, warnings. "No Smoking" boards. Warnings of explosion risk, etc. to be clear and plainly visible, suitably placed in the shop or on equipment.

Health precautions. Explanation and description of paint compositions, (percentage of harmful components), their inflammability (flash point), provision of operating instruction plates on equipment, warning notices, issue of appropriate working clothes, provision of adequate space ventilation and proper washing and cleaning of working spaces.

Warning colours. Dangerous, moving or projecting parts of equipment and machinery, electric wiring, piping with hot, inflammable or corrosive solutions, etc., to be clearly painted in standard warning colours.

Conveyor paths. Sheet or wire mesh guards round chain sprockets and open roller suspensions under 190 cm height of space, accessible switch points for quick stopping of driving motors, shear-pin safeguards against overtensioning and chain breaks, for installations of appreciable size.

Some exemplary embodiments of the above-mentioned safety measures can be seen in the illustrations as follows : Fig. 2 shows a casing for the chain sprockets of piece conveyors. The low-hung suspension rollers are here protected by the tubular shape of the carrier rail. Fig. 3 shows, on the wall to the left, close to the equipment, the low-voltage switches for the tunnel section also visible, which are located so as to be quickly accessible in conjunction with pipeline stop valves, etc. A switching point for a conveyor drive is shown in Fig. 5, on the front, higher chain strand. These switch boxes enable quick stopping of the drive. Protection of heating radiators from falling bodies by wire mesh grids is shown in the interior view of a drying room, Fig. 13.

The structural separation of a painting room from the grinding (rubbing-down) room is shown in Fig. 4, from a wooden-furniture painting shop. The closed-loop conveyor is in this case led through conveyor openings in the walls. Fig. 17 shows a freely-suspended, space ventilating duct into which, contrary to perforated ceilings, dust cannot enter and settle, even with the rising, heated air. A handy switchbox for all units comprising a paint-spraying station is shown in the continuous installation in Fig. 24. The arrangement of two different patterns of explosion-proof ceiling lights is shown in Figs. 24 and 26. In both cases, the lights are nevertheless located in the path of a fresh-air current.

Fig. 19 shows a paint store and distributing point with the standard form of feed to the user points. This arrangement gives the greatest degree of security. The supervision, servicing and operation of a large, tunnel assembly is, as shown in Fig. 27, facilitated by the provision of inspection windows and doors, and is also safer than giving access to the interior at the tunnel ends. A low bounding wall or kerb prevents paint from flowing out into the shop ; and Fig. 28 further shows the casing, catching bar of a flow-coating installation.

Fig. 6 shows a doorless conveyor opening in the wall of a drying chamber, which in an emergency can act in the same way as the explosion flaps formerly required. Air-washing, with a covered and accessible paint-draining point on the left, is shown in Fig. 7, illustrating a spraying cubicle. A tunnel arrangement for surface cleansing which is sufficiently enclosed also affords a good health safeguard, as is partially visible in Fig. 8. The adoption of mechanical work-piece conveying also eliminates the dangerous inhalation of paint fumes from dipping tanks. The best solution from the point of view of plant safety and health protection, of the paint-application problem is that shown in Fig. 11 in the form of an automatically-operated flow coater, for large work-pieces which had previously been treated by usual, manual spraying methods, with the accompanying disadvantages. The illustration also shows that this installation has been accommodated in the comparatively high side-bay of a still loftier, main shop, so that

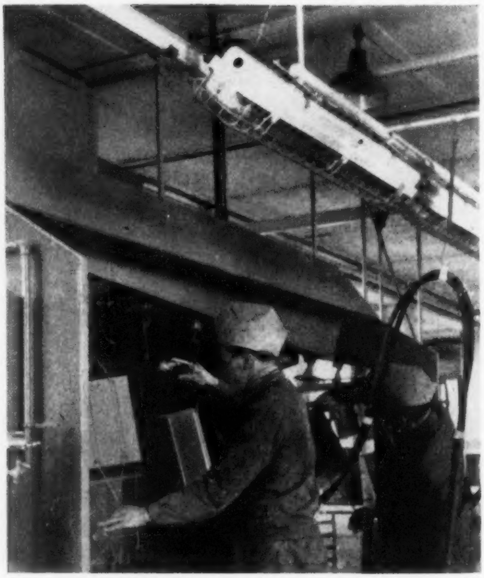

Fig. 26.—*Artificial lighting of a manual paint-spraying station.*

the solvents evaporating along the conveyor paths can draw off to the gable of the main shop, being further assisted by the slope of the roof and the usual, rising air currents. This additional ventilation provided by the loftiness of the shop is a favourable respiratory safeguard and would be lost if the side-bay were structurally partitioned from the main shop and could not be replaced by any intensification of the shop ventilation or that in the side-bay, since effective extraction of evaporating solvents is seldom to be obtained on long conveyor paths, particularly where work pieces of large surface area are involved. This has been pointed out as it is often found that the air circulation in enclosed spaces of limited volume, such as frequently result from excessive subdivision in the paint shop, is inadequate ; and that in such spaces, even multiplying the usually locally restricted air intakes and exits is incapable of replacing the natural and more extensive updraught attainable in large and lofty spaces. Where possible, the height of the space should not be too sparingly dimensioned.

Type and Subdivision of Shop Spaces

As already indicated, the more or less generally applicable safeguards and safety measures which are defined in further detail by the rules and regulations in force can only be correctly and suitably applied if they are treated in the light of the particular circumstances and conditions prevailing in the paint shop or painting plant under consideration. This also embraces the question of buildings and space utilization and the not infrequently desired provision of fireproof partitions between the stages of the painting operations : surface preparation, paint application, paint drying, grinding, polishing and rubbing down, etc.

Such a subdivision of the building space, *i.e.* into separate working spaces, is nowadays as a rule only acceptable from the point of view of production economy and has partly also been the practice, where there is no true flow production in conjunction with work conveyors, or where static units such as cabinet stoves and the like are in use. Such subdivision will usually do nothing to improve safety, except in the rare exceptions, when highly-inflammable working materials, unfavourable location of the paint shop (next or under storerooms) and the like may dictate its uses.

For every added partition restricts the view, fosters the concentration of fumes and paint mists, and offers the temptation to set down paint drums, work pieces and accessory gear, in all manner of places. The more room corners there are, the more difficult it is, as proved by experience, to maintain order, tidiness and cleanliness. A form of construction favouring such conditions must therefore be regarded as dangerous for the security and safety of the plant. Subdivision into separate working spaces, which is seldom really necessary for technical or health-protection reasons, will also rarely diminish the fire risks.

Surface treatment, for instance, is, apart from the properties of the fumes and solutions of aqueous cleansing media, such as are predominantly used, not an inherently dangerous processing stage ; nor is the grinding (rubbing down) and polishing shop, so that, as regards the equipment itself, it is only the paint application stage, and, if old-fashioned stoves are used, paint-drying, which remain as fire or explosion risks.

In the widespread floor spaces such as are required for continuous flow production, not only are supervision, servicing and cleaning greatly facilitated, but firefighting, should an outbreak occur, is also much easier ; in the case of a modern, appropriately designed painting shop, such small outbreaks may even be allowed to " burn out " without doing any harm. Furthermore, experiments have shown that even freshly-painted metal surfaces on a chain conveyor usually take fire and burn very slowly, so that the other parts of the conveyor are not always necessarily affected. The linking of working spaces and equipment assemblies by conveyor belts should not, therefore, except very occasionally in any way promote the spreading of an outbreak of fire anywhere in the plant. In any plant dealing with metal articles, furthermore, the danger zone is restricted to the conveyor paths

between the paint-application point and the drying unit (freshly-applied coatings).

Conditions are quite different, however, in the paint shops of woodworking factories. In that case, a very closely-packed conveyor track may favour the spread of a fire ; in most cases, however, the otherwise requisite spacing of the suspended workpieces should prevent the flames from striking across the gap. On the other hand, if the painting room is of fireproof construction, of suitable height, and if the equipment itself is made of incombustible material, even a fire on a conveyor track should, if only by its greater accessibility, be easier to extinguish than, for instance, an accumulation of identical workpieces in a more confined space (more smoke), stacked against walls. The flame spread will, furthermore, always be less from pieces hanging on a conveyor belt than from a stacked accumulation.

Consequently, where a production line is to be arranged on a large floor space, subdivision into a number of compartments is only very seldom necessary, in the interests of plant safety. Examples of both forms of arrangement will be seen in the accompanying illustrations.

Danger Points in the Paint Shop

The danger spots in a paint shop include particularly spraying cubicles with dry separation, in which the dust deposits constitute a permanent risk, and the use whereof, especially in paint shops handling wooden articles, is irresponsible. When such installations are located in the centre of the plant and no automatic fire-extinguishing appliances are provided, the consequences of an outbreak of fire, especially at night, can be devastating. Spraying cubicles with wet deposition, which can nowadays be used alternately for different types of painting are very considerably safer.

Fig. 27.—Observation window and servicing door for a paint drying tunnel.

A further danger spot in quite another sense is the box or chamber stove of obsolescent design, in which natural ventilation (thermal convection from below) and direct heating by naked gas jets may still cause explosions. The cause is in part the enclosed form of construction, which may be a source of danger, even in modern designs, if any control element fails. This type of stove, which even nowadays often lacks explosion shutters, is in sharp contrast to the open, continuous tunnel stoves without means of closing, which present a far smaller risk.

From the standpoint of health risk, the open type of dipping tank for surface treatment as well as for paint application is also a danger point, since the enforced inhalation of fumes while working around open tanks is definitely injurious to health. Mechanical surface cleansing in closed casings should be aimed at here, irrespective of the process liquids to be used. Conditions are still often unsatisfactory in this regard, and are not covered by any statutory regulations.

Finally, mention must be made of the risks attending the use and handling of paints, in which flash point, which is at the present day covered by a multitude of regulations, may be of decisive importance for the correct layout of individual units, the painting spaces and general risks. A difficultly-inflammable and slow-burning type of paint enables, if solely or principally used, a favourable layout. Large, exposed paint volumes (dipping baths) and application methods involving intensive atomization must be more critically regarded, particularly with respect to the material of the articles treated (inflammability), the type of equipment and the nature of the surroundings of the paint shop.

Unless very large quantities are involved, the actual volume of paint handled is no true measure of the risk involved, for instance, having regard to the flash-point factor. Regulations concerning quantities must be interpreted in the light of surrounding conditions and attendant circumstances. Thus, a small, statutorily-permissible quantity of highly inflammable paint (*e.g.* the cellulose varnishes) can in corresponding circumstances (dipping of small pieces, electric light bulbs, cardboard packaging) involve more serious risk of fire damage than the burning of a far larger quantity of quietly-burning, ordinary spraying paint inside a modern, fireproof spraying cubicle.

Summary and Recommendations

Safety and health protection can be increased and improved by the following means :—

(a) The use of fireproof materials in the construction of all buildings and equipment.

(b) Mechanized conveying of all workpieces and thus a relief from toilsome operations.

(c) Mechanization and automation of all workstages and processes with consequent elimination of the human fallibility factor.

(d) The use of open, continuous processing units (tunnel stoves, washing tunnels, etc.) instead of closed stoves, dipping tanks, etc.

(e) The use of aqueous solutions for surface treatments and their automatic application.

(f) The use of paints with the highest possible flash point and their handling and processing in closed pipelines and apparatus, such as flow coaters.

As will have been seen from the above, all efforts to increase both working safety and economy tend in the same direction towards the use of continuous, " production line " equipment.

COLOUR POLICY

The general principles and experience in the painting (internal decorating) of industrial buildings and installations are not entirely applicable in the case of industrial painting establishments. This applies particularly in the case of establishments in which articles are painted in many different colours, which already introduce a colour scheme into the paint shop.

This colour effect, further enhanced by the suspension and motion of the multicoloured work pieces on the conveyors, can be of quite considerable intensity and where it is not a case of pale or light-coloured work-pieces, can introduce a disturbing note into the shop, especially in conjunction with highly-coloured walls and equipment.

It may therefore be quite generally said that without knowledge of the colours and shades to be used in the processes, an effective colour scheme of internal decoration in the ordinary sense will seldom be practical in a paint shop. Besides this, the colour scheme of the interior of a paint shop should fulfil other, practical functions, in aiding manual operations, proper attendance to the equipment, supervision, etc., which are of paramount importance.

The upper parts of the working spaces, such as the ceilings and the tops of the walls can be excluded from such considerations, since on account of their elevation they do not affect either the conveyance of the work pieces or the contrasts necessary for convenient working and supervision. Since these high parts of the shop are also less exposed to soiling and contamination by the working processes conducted therein, their colour scheme

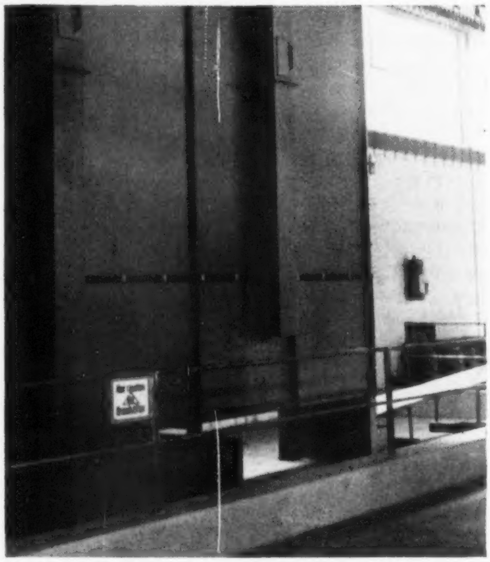

Fig. 28.—Access barrier and earthing bars of a flow-coater unit.

can in great measure be determined by considerations of appearance and the diffusion of light by reflection.

In the lower parts of the shop walls and equipment, however, practical considerations must prevail in the choice of colours. This concerns particularly the choice of contrasting colours to the colours of the conveyor equipment and the work pieces being handled. Subdued colour tones are suitable for shops where multicoloured goods are being produced. For unpainted workpieces in the grey tones of the ordinary sheet metals, or articles of dull or monochrome colour, a suitable contrasting colour is a brighter, light wall paint, since that will enable the movement of the work-pieces along the conveyors, the degree of occupation of the latter, etc., to be perceived and supervized from a distance, since it is a matter of experience that, where stationary or moving work pieces are clearly visible in front of their background, of walls, machines, door and openings, the supervision of the processes and the control of production are much facilitated.

It is further to be considered that any processes of surface treatment are always accompanied by heavy contamination of the surroundings with solutions, paint splashes, dust, etc., and that, consequently, many wall sections, articles of equipment, installations or parts such as spraying cubicles, dipping baths, derusting and lye baths, can often not be kept clean by the usual cleansing methods. In addition, there are the effects of corrosive solutions, high temperatures or long-

continued heating and the like, which rapidly act deleteriously on coloured and, in particular, light-coloured paint coatings. For such surfaces or articles, a dark colour tone, which absorbs splashes of paint or process solutions, or even a colour tone matching these splashes would definitely be suitable.

This does not apply, however, to all forms of contamination and a distinction must be made between contaminations such as fresh paint sprays, process solutions and adherent fumes, and the superficially-deposited, dust-like, usually dry and easily-removable contaminations. If the latter predominate, it might even be advisable to use a really light colour tone, so that any dust deposits shall be the better visible.

The above indications and distinctions, similarly, cannot be applied to every kind of painting installation. In certain branches of the industry, *e.g.*, in the painting and varnishing shops of furniture factories, in which many colourless or light-coloured finishes are used, contaminations seldom cause difficulties in application and the colour schemes and contrasts in the working spaces, equipment and the workpieces travelling on the conveyors will remain longer intact and will enable a freer choice of colours. On the other hand, to name but one example, if an installation handling goods to be painted red is itself painted in a beige colour, the results will only be a very unpleasing mixture of colours, or involve the necessity of very frequently painting over splashes of contrasting red and beige. Consequently, the function of each item of equipment and its effect on the general colour scheme must be carefully verified ; taking into consideration not only contaminations as such, but also chemical and mechanical influences and stresses, as well as temperatures and lighting effects, if the adopted colour schemes are to have permanent value. The normal, age-bleaching of paintwork must also be taken into account, but is not of such serious importance since, apart from warning notices, muted colour tones are almost always preferred.

Continuous spraying tunnels for manual paint application almost always require the work pieces to be visible against a contrasting background. Such a contrast between the work and the background helps the sprayer to handle his tool properly, since, at the same time, the pieces following in automatic sequence, are more easily seen or recognized.

Obviously, all these considerations and intended effects can only attain permanent value if cleaning and repainting are properly attended to and done when necessary.

Having regard to the diversity of conditions found in paint shops generally, it is clear that the most suitable paint (colour and material) for any particular case will have to be selected according to the work being done, the colours to be used, the purpose of the whole operation, the possible effects of contamination, lyes, acids, temperatures, etc. Consequently, no general rules can be laid down for colour-selection and painting policy ; apart from the standard colours, prescribed and used, for equipment details, piping and the like.

However, since nowadays hardly any plant will paint its shops and equipment grey, some hints on colour policy will now follow, which have accumulated from recent practice and have been found useful.

Colour Schemes

Internal Spaces and Walls

a) Ceiling and upper part of the walls, usually a light colour, depending on circumstances (skylights or window lights), acting to brighten and increase the apparent size of the enclosed space and increase prominence (light diffusion, reflected light on shadowed walls).

b) Lower parts of walls : average light to dark wall colours, depending on the siting of the equipment, its distance from adjacent walls, usual contaminations and the material of the work pieces (*e.g.*, light-coloured woods, dark-coloured steel plates), as well as the colour shades to be used.

Walls Immediately Adjoining Equipment

Up to 2-3 metres around the particular unit (*e.g.* a spraying point), darker in contrast, since splashes, dust, etc. will be met, and wherever units are set directly against a wall.

Backgrounds of Conveyor Paths (such as free walls, and the insides of tunnel units).

a) A contrasting colour to the colour of the workpieces (to facilitate viewing of the spacing of workpieces on the conveyor, rate of advance, etc.)

b) In the case of bright, multi-coloured workpieces, or after painting, a perceptibility lighter or darker, neutral, blended colour tone.

Paint Spraying Stations

a) The surroundings of the work-pieces (background, side-walls) : a contrasting colour to the colour of the unpainted pieces, for the purpose of bringing the outlines into prominence.

b) Outside of the equipment casings : principally blended colours, depending on the colour of the paint being used (paint-mist adhesion); since the outsides of the casings are not regularly cleansed, as are the insides, and can be sprayed with removable, coloured plastic foil coatings.

(*Continued in page* 268)

The Planning and Construction of Industrial Paint Shops.

(*Continued from page* 267)

Other Equipment Subject to Contamination

a) In the case of adherent contaminations, such as paint splashes, drops, fumes : colour not too light ; perhaps even the same tint as the solution used in the installation (otherwise, frequent over-painting necessary, *e.g.*, in the case of paint and solution, dipping baths).

b) When the contaminations are not adherent : *e.g.*, dry grinding or spraying dusts, etc. : light colours, facilitating recognition of the deposits and indicating the necessity for cleaning.

Tunnel Units, such as continuous stoves and tunnel washers

a) Casings of hot and heat-emitting installations : a cooler, contrasting colour tone, preferably of some heat-resisting and, if possible, heat-insulating kind of paint.

b) Passages and openings : preferably in a contrasting colour to the predominant, surface colouring of the work-pieces (improves visual observation of the passage of the work pieces from a distance).

Projecting Parts

As customary, painted yellow or yellow banded with black : (low conveyor rails, casing edges, service ladders, etc.).

Moving and Possibly Dangerous Parts and Equipment Units

As usual, painted red ; items or assemblies ordinarily only accessible after removing guards or casings (fans, pumps, motors, etc.) may well be included (easier recognition of all equipment in the paint shop, requiring periodical, regular servicing and attention).

In practice, it will not be possible, to make use of all these suggestions : depending on the particular case, there will be special requirements to meet, having priority over other considerations.

Space Lighting and Colour Effects

Exaggerated effects should be avoided at all costs. A harmoniously-matched colour scheme of attractive, subdued colour tones should always be preferred to a polychromatic scheme, where high-intensity, interior illumination is intended. In this sense, the many pipe lines and conduits will also only be marked at intervals, with bands according to the standard colour code, for air, water, hot water, steam, oil, lyes, acids, electric current, etc.

Lighting conditions (natural daylight, artificial illumination, etc.) and the type of lighting fittings installed also require special consideration, since these, in the same manner as the customary, bluish-green sunshade painting of shop windows and skylights, will greatly influence the appearance and effect of the painting scheme used. Either somewhat cooler or somewhat warmer colours may have to be chosen for the whole accommodation and equipment.

Space illumination should, consequently, neither tend towards an orange tinge (incandescent bulbs) nor towards a too cold greenish-blue shade (mercury vapour lamps). For general space illumination, white fluorescent lighting will probably be the most suitable ; while for the illumination of the actual equipment and apparatus, a somewhat warmer light could be chosen, increasing the sensation of comfort. As a matter of fact, in the case of flow production lines, the actual differentiation of colour tones is not of primary importance, since the actual paint shades have in any case to be checked before preparing and applying the paints. The correct colour tone must therefore be apparent, in the first instance, in the conveyor line after the paint driers (inspection, acceptance).

It should be underlined that a correct colour scheme improves visual perception and aids distinction (work organization), assists servicing and maintenance of the equipment, facilities control (fire prevention), improves output, increases comfort and reliability, and thus, reduces accidents and damage to equipment.

NEW METHOD FOR SPALLING RESISTANCE OF PORCELAIN ENAMEL

A.S.T.M. Committee C-22 on Porcelain Enamel has completed a method to determine the spalling resistance of porcelain enamel on aluminium. This method is based on immersion of coated panels in an ammonium chloride solution. There has been no authenticated case in which specimens have passed this test and then failed in service.

A method to determine the thermal stress and strain produced by procelain enamel in metal substrates is under development. An enamelled strip of steel acts like a bimetallic thermostat, and a differential transformer is used to measure the specimen deflection. In this manner, the stress behaviour of various combinations of enamel coatings and base metals can be determined. This method may also be used to study the differential thermal expansion behaviour of dissimilar metals bonded together by ceramic adhesives.

Interlaboratory work is continuing on the method of determining the coefficient of expansion of porcelain enamel. Also being investigated are methods for impact, continuity of coating by high- and low-voltage breakdown tests, and the sag characteristics of steel during firing of porcelain enamel coating.

METAL FINISHING CONFERENCE

Llandudno May 2 to 6, 1961

A Report of the Annual Conference of the Institute of Metal Finishing

(Continued from page 233 June Issue, 1961)

ELECTRODEPOSITION OF RUTHENIUM

by F. H. Reid* and J. C. Blake*

THIS paper represents only a preliminary appraisal of the possibilities of aqueous electrolytes for ruthenium plating. Choice of starting materials and solution composition has been largely empirical and dictated mainly by the ready availability of certain basic compounds. No intensive development of electrolytes of completely different types from those described in the rather sparse literature has yet been attempted.

The cathode efficiency of the electrolytes is always low, but not impractically so, and likewise, the presence of micro-cracks in some of the deposits need not detract from their potential usefulness, since a similar tendency in electrodeposited rhodium at comparable thicknesses has not hindered the extensive use of the latter for many years in a variety of critical electrical contact applications, in which the suitable selection of undercoating deposit is recognized to play an important role.

The most immediate useful electrolyte for ruthenium plating appears to be the nitrosyl-sulphamate solution, which is stable in operation without special precautions such as arise of diaphragm cells, and, provided that the ruthenium content is maintained at or above 5 gm. per l., is not troublesome from the viewpoint of evaluation of tetroxide at the anode. It seems likely that addition of aluminium salts to this solution would contribute to a reduction of the incidence of cracking, but in the absence of sustained testing the conclusion may be regarded as tentative.

Although the simple sulphamate electrolyte gives slightly better performance than the nitrosyl-sulphamate solution, its limited life constitutes a serious disadvantage. This might well be overcome by the use of a diaphragm cell with separate anode and cathode compartments. A similar consideration applies to the sodium tetranitro-nitrosyl-ruthenate/sulphamic acid electrolyte, which apart from the stability factor, appears to be the most promising solution of those tested, with respect to the very low incidence of cracking of deposits. Both electrolytes are currently being tested along these lines.

Electrolytes based on ammonium nitrosyl-pentachloro-ruthenate appear to offer no advantage over the nitrosyl-sulphamate solution, other than a possible improvement in reproducibility.

Ruthenium resembles rhodium in its general characteristics. In the applicational field, the

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place for ruthenium *vis-a-vis* palladium and rhodium remains to be established but, whatever specialized uses may develop, the electrodeposited metal offers almost immediately a possible economic alternative to rhodium in electrical contact applications, and in this context preliminary assessment of corrosion resistance, wear rate and resistive noise levels for ruthenium coatings 0.0001 in. thick on brass have indicated that their performance does not fall far short of that of rhodium of similar thickness.

DISCUSSION

MR. R. R. BENHAM (Johnson Matthey and Co. Ltd.) said that the paper filled a gap in the information on the electrodeposition of ruthenium, and was commendable for providing details not only of the best electrolyte found but also those of indifferent performance.

Cathode efficiency was stated to be 21 per cent at a temperature of 90° C. and there was, presumably considerable evolution of hydrogen. Did this give rise to hydrogen pits in the deposit, such as sometimes occurred with rhodium plating? The problem of loss of the volatile tetroxide from the anode seemed a distinct disadvantage, and must be overcome before the bath could be exploited commercially. In the paper 2.5 gm. per l. of Ru was stated to be the essential minimum, below which the tetroxide was not evolved. Was that the complete position, or was there some small evolution below that concentration.

It was stated that good deposits of up to 0.0002 in. were obtainable. While this might be satisfactory for many applications it was on the thin side for heavy-duty work. Could some information be given on the quality of thicker deposits? Why had the upper limit been set at 0.0002 in.? It was said that Ru, like Rh, was subject to spontaneous cracking at about 0.0001 in. unless additions of aluminium or magnesium sulphate were made to the electrolyte. Selenium had in the past been used for this purpose in Rh baths. Had it been tried in Ru solutions?

Effect of Undercoat on Cracking

Reid and others had shown that the incidence of cracking was influenced by the undercoat, *e.g.*, in the case of Rh it was considerably less on an undercoat of silver than on one of nickel and it would appear to be true also for Ru. The drop in cathode efficiency with Ru was certainly unexpected and he could recall only one other similar reference (by Parker in an article in "Plating" in June, 1958), in connexion with barrel gold plating. He had attributed it to the normal decrease in throwing power with increasing concentration of gold.

Referring to the preliminary flash with gold or a similar substance in order to prevent attacks by the electrolyte, had the authors considered striking the Ru solution at a higher current density to achieve direct deposition on to base metals?

In giving information about occlusion of non-metallic material in deposition from a solution containing aluminium, the authors said that spectrographic examination, except in the case of the latter substance, had been inconclusive. He would have thought that if aluminium were present in some form it would be detected quite easily spectrographically.

The nitrosyl-free electrolyte appeared more promising than the sulphamate solution, apart from the loss of tetroxide. The authors stated that the use of a diaphragm cell might be the answer to the problem. Had they any further information on the point of application of Ru? If it could be confirmed that deposits would withstand higher intensity arcing without pitting, it would be a valuable property which might find application in sparking plugs.

It seemed that Rh would continue to hold its place in high-frequency contact applications because of the lower resistivity of 4.3 microhms compared with 7.6 for Ru. Ru had a reflectivity of 63 per cent compared with 79 per cent for Rh; Ru, therefore, might not be acceptable for domestic use. The darkening effect was more noticeable, of course, on articles with internal reflections where the loss of reflected light was more apparent.

On behalf of MR. HOPKINS, he then put the following additional questions to the authors: What is the effect on the deposit, and on the life of the bath, of using a divided cell? What is the effect of less acid being present? What compounds build up in the solution after a Ru turnover of 250 per cent.? Does the cathode efficiency of the bath alter with use? Are there any signs that the solution ages with use or on standing? What are the effects of the use of addition agents such as sodium phosphate or sulphate or the salts of a sulphamic acid?

MR. J. M. SPRAGUE (Consulting Electrochemist) said that the authors had deliberately presented their results in terms of a formula for their starting material which was not really correct. The more complex formula might throw more light on the results. Were the two Ru atoms acting with different valencies? If so, could this have any bearing on the current deficiency? Was it possible to start with a Ru compound in which the Ru content operated with a single known valency? It might be useful to try to ascertain what ions were concerned, giving a guide to what one was operating with, or might try to operate with. The authors had given a tentative explanation for the rather surprising decline in efficiency with increased metal content. Was it possible that as the metal content was increased the complexing iron that

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was there was increased as with a cyanide solution?

Referring to undercoating, he said that when a metal was stripped from its substrate it simply meant that the stress in the deposit was greater than the forces of adhesion, and it was possible to decrease the one or increase the other. The soft metals gave better adhesion. Would it be possible to try something less expensive than gold yet a soft metal in which the stress in the deposit might ease itself to some extent. Was it possible, without embarking upon complications, to consider the use of stress relievers?

Cathode Efficiency

DR. T. P. HOAR (University of Cambridge) asked why was the cathode efficiency for the deposition of a noble metal so extremely llow? From Fig. 2 in the paper it seemed that the cathode efficiency went up sharply with temperature. Ru was a noble metal, and the reason must be that the over-voltage was astonishingly high. This fitted in with increased cathode efficiency with increased temperature in suggesting that the over-voltage was much higher than that for hydrogen, and had a high temperature co-efficient as it were.

Authors' Reply

MR. F. H. REID, replying, said that Ru, Rh and other precious metals were bound to be bracketed together in discussion, because they were superficially similar at least. They had been glad to include the results of unsuccessful experiments because sometimes the successes only tended to be emphasized, and the failures passed over. They hoped to give anyone else who took up the work a sufficient basis on which to proceed. They had not found, with Ru plating, hydrogen pitting due to low efficiency, such as occurred to some extent with Rh. Deposits were normally fairly smooth : there might be a little pitting here and there but it was not troublesome.

The point they had been trying to make in regard to ruthenium tetroxide was that its evolution was very easy to detect by smell, even at very low concentrations. If one could not smell it one need not worry about it.

They had limited the thickness of deposit to 0.0002 in. for the sake of convenience. This was quite sufficient for almost all of the applications that could be foreseen.

They had made the point that the effect upon cracking of the undercoat was marginal. A highly stressed deposit would cause bad cracking on almost any undercoat. When they had spoken of cracking they had been referring to a kind of borderline between two extremes where the effects were rather magnified. He would agree that silver or gold would tend to relieve the stress because it was soft but this was a factor about which one should not be too forceful. On the question of the "mysterious" decrease in cathode efficiency with increased Ru content, he had a feeling that it was probably deposited through a cathode film: that in increasing the Ru concentration they were thickening the film. This was a very broad view, and they would not care to go beyond it at this stage.

They had tried a high current density strike to overcome the effect of poor adhesion, and the results had not been promising. There was a similar situation with Rh and the nitrosyl groups. It seemed a feature of this type of bath that the deposit went on perfectly well but after two days or so began to fall off.

The spectrographic results had been inconclusive because their standards were not sufficiently high—indeed, none were available. They had not intended to imply that there was no significant degree of aluminium in the deposit. They would try to confirm this. The use of diaphragm cells had been referred to. He could only say at this stage that though it was an obvious step to take

the results had not been very promising. To take a simple sulphamate bath as an example, with the diaphragm cell they tended to get rather blackish deposits on the cathode. This was the practical result and work on these lines was continuing. He would not like to be definite at this stage.

Acid concentration did not seem to have a very big effect—indeed no measurable effect—on the deposits in appearance. As to what compounds built up on the solution after use, the chemistry of the Ru compound used was very abstruse. The formulae quoted in the paper were obtained as a result of work carried out at the Battersea College of Advanced Technology, and the chemistry had been very involved. Mr. Sprague and Dr. Hoar had referred to the theoretical aspects. He agreed that they should look into the bath measurements on the lines suggested. This was, however, a piece of applicational research. Results would always be very hard to interpret because of the complications inherent.

It was difficult to see where Ru would be used. He felt it would find its own applications. Mr. Benham had said that Rh would be better in high-frequency circuits but the conductivity of the electrodeposit was not necessarily the same. One should not apply the values for wrought metals to electrodeposits. There were signs that the addition of palladium to the bath might give increased cathode efficiency.

On the question why there was a low cathode efficiency with a noble metal the only reference he could give was a paper by Lyons in which he had referred to the so-called "inner orbital" patches which these metals formed so easily. They were very strongly complexed. The metals could be deposited from aqueous solutions as the stability of the metallic state was very high.

Mr. Sprague had referred to the fact that exfoliation occurred when the forces of stress were greater than the adhesion. He did not think this was strictly true ; rather that if one got a deposit with good adhesion the stress would not be large enough to pull it off. Stress was a horizontal force, and the component of stress pulling upwards was very small. Exfoliation was always a sign of good adhesion, which could be established by various means with which they were familiar. Ru was a rather unusual metal.

ELECTRODEPOSITION IN PLAIN BEARING MANUFACTURE

by P. G. Forrester*

ELECTRODEPOSITION has been used for providing bearing linings of numerous different metals. Silver and silver-lead are the only electrodeposited materials which have been used on a large scale to provide complete linings. Plating, is however, the standard method for providing the thin lead-base overlay on copper-lead bearings, which are among the principal high-duty bearings in current use.

Main and big-end bearings are produced to very close tolerances on wall thickness. A total tolerance of about 0.00025 in. is the general rule for small bearings up to about 4 in. diameter, using the overlay plating process, and of 0.0005 in. for larger bearings. This accuracy can be obtained in one of two ways. The first method is to machine the bore of the unplated bearing, then to plate to an oversize wall thickness and again machine to the required thickness. Alternatively, the second machining operation may be omitted, and the required accuracy obtained by extremely close control of the plating solution.

Two different methods of plating are used. The first of these uses an anode placed centrally in a cylinder formed by two stacks of half-bearings. In a solution such as the lead-tin fluoborate solution, in which current distribution is determined largely by geometry, this method is capable of breat accuracy. One disadvantage is that of carrying out electrolytic cleaning processes before plating on the bore of such a cylinder.

The alternative method is that of plating through a slot. This method uses a non-conducting rectangular box, one wall of which has a central slot along its length and the bearings are placed with the bores facing this slot. The simple slot tends to favour plating away from the centres or crown of the bearing, a tendency which can be reduced by means of baffles placed along the slot.

Both slot and cylinder methods give good results, but in both methods the problem arises of finding insulating materials for the jigs which can resist the necessary cleaning and plating solutions and which will stand up to daily use. The author suggests some of the newer plastics.

Certain aluminium alloys provide a suitable combination of hardness and strength and by the addition of metals such as tin, which form alloys with soft phases, good bearing surface properties can be obtained. Development of such alloys was for some time retarded by the difficulty of bonding these alloys to steel and by the relative weakness of cast high-tin alloys.

Aluminium alloys have also been used to a limited extent as an interlayer for overlay bearings, in place of copper lead. Their performance is limited by liability to fatigue, cavitation and wear, examples of which the author gives in the paper. Probably the only advantage of aluminium as an interlayer is that if the overlay fails the interlayer will not corrode.

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H. Lippman (Roto-Finish Ltd), E. W. Fondyga (Roto-Finish Ltd.), J. Jamieson (Roto-Finish Ltd.), and D. A. Clewes (Roto-Finish Ltd.).

Electrodeposition is also widely used as a corrosion protection for bearings and to assist in obtaining a bond in various types of bimetal.

DISCUSSION

DR. D. N. LAYTON (Ionic Plating Co. Ltd.) said that a point of particular interest to electrodeposits was alloy deposition for bearing materials. A number of the alloys with which the author would no doubt like to deal, *e.g.*, antimony, had high hydrogen over-voltages and this led to complications in depositing the metal on its own. He felt that the problem of depositing alloys on some of these metals would only be solved if, instead of the empirical approach used so far, there were a more fundamental one involving the investigation of the basic electrochemistry of the processes.

Also of interest was the method used by bearing manufacturers to obtain uniform deposition in half shells, and the use of slots in a plastic shield as the anode. This gave an effective line anode down a jig made up by stamping a number of semi-circular shells on top of each other. So often electrodepositors faced with a bad deposit distribution took the current off the high-density area and produce a high density over the area in which they were especially interested. This was only making a bad current-density distribution even worse. One should prevent the current getting through by using a plastic shield, such as the sheet with the slot down the centre.

The only quantitative data on the subject was in the patent literature and one or two of the papers by Mohler. He would add that one of Schaefer's American patents contained some quantitative data which was not consistent. The deposit distribution and thicknesses were not consistent with the claimed plating conditions. If the slot was made narrower eventually a completely uniform deposition around the half circle was obtained. The slot width had to be about 11 per cent. or less of the half shell diameter. But if the ears were put on the slot, as shown in Fig. 4C in the paper it was possible to open up the slot to between 25 and 38 per cent. of the shell diameter so reducing the losses in deposition. The purpose of the ears was to make a wider slot possible. He would like to know how "fatigue strength" in Fig. 1 was defined and calculated.

Fatigue

MR. R. A. F. HAMMOND (Armament Research & Dev. Establishment, War Office) said that the author had made it clear that one of the mechanisms of failure in bearings was that of fatigue. Was it a question of straight fatigue or corrosion fatigue? If it was straight fatigue, was there any possibility of reducing the risk of this by incorporating some addition agent in the bath, one that would give compressive instead of tensile stress in the deposit?

A SPEAKER said that from the paper it seemed that the fatigue in the top coating had not spread to the underlying coating. Were these examples of non-propagation of fatigue cracks and therefore of little consequence? In Fig. 7 in the paper the fatigue crack apparently did not go through to the underlay. Was it a case of the fatigue crack resulting in the detachment of the coating rather than propagating to the basic material to cause failure of the part?

Author's Reply

MR. P. G. FORRESTER, in reply, apologized for not having expressed himself with sufficient clarity on the question of fatigue. The phenomena of bearing fatigue was fairly well-known but not at all well understood. If a bearing was overloaded, and too high an alternating compressive stress

applied, it cracked. There was much literature on the subject but little progress had been made towards elucidation in the last twenty years. The limit figure for a given material was fairly consistent, and if it were exceeded cracks having all the appearance of being due to fatigue appeared. They occurred after a specific number of reversals and followed the usual pattern. They began at the surface and ran down until they were fairly close to the bond with a stronger material, then along this and back to the surface or, alternatively, joined another crack in so doing. Ultimately there was complete separation of pieces. In view of the high oil pressures, 3,000 or 4,000 lb. per sq. in., penetration of cracks could occur, with consequent damage to the lining. If it was just an overlay lining the effects were not catastrophic because it would only wear, but if a whole lining was involved this simply disappeared.

He had not previously heard it suggested that one might deliberately insert compressive stress. It was interesting, but it might be difficult to maintain a compressive stress in a soft material, though not impossible. Perhaps some of the unresolved difficulties might be due to differences of that kind. He added that the method of testing adopted had been to build a bearing testing machine which applied these alternating stresses, operate it for a given number of reversals and observe the extent of failure in the bearing.

He did not think that corrosion fatigue was involved. He had looked for this but had not been able to observe any difference in effect as between different lubricants. Some were, of course, inhibited. It did not seem to have any effect in the alloys named but did appear on a large scale in copper-lead alloys. The lead phase was attacked and this weakened the whole structure.

One should not be concerned to get compositions identical to those which proved successful in the cast form, but rather think in terms of the properties desired. What was required was a material based on tin or lead with a hardness of about 25, and running down to about 10 at 160°C. Cadmium had been used a good deal at one time, but it had not been sufficiently superior to tin or lead to justify further development.

EXPERIENCE WITH AN ION-EXCHANGE PROCESS FOR THE RECOVERY OF WATER POLLUTED IN METAL-FINISHING OPERATIONS

by A. A. Pearson* and G. G. Parker*

THE authors describe a process, based on ion exchange, for dealing with waste water from metal-finishing operations. It provides a re-circulatory system of water supply with an average flow of 7,500 gal. per hour in a 90-hour working week. From an input of wastes containing mixed metal ions, chloride, sulphate and cyanide, a good-quality demineralized water is obtained for re-circulation.

Various factors peculiar to the circumstances were considered before the type of plant was decided and compared with the limits indicated by the local (Oxford) authority. It was eventually decided that the plant should consist of two mixed bed ion-exchange units, fed through one of a pair of sand filters from a sump holding 7,000 gallons of swill water. The de-ionized water should be recirculated to the plating shop at an average flow of 8000 gallons per hour, with a head of 40 ft., the quality controlled by conductivity cell and meter. The plant was designed to cope with an effluent having an ionic load equivalent to 225 p.p.m $CaCO_3$ with an acidity of 35 p.p.m HCl.

The path of the waste water feed to the plant was intended to be controlled by a conductivity cell placed in an appendix to the main flow, diverting the stream according to the ionic load, through automatic valves either to the sump or to the strong acid pump.

The strong acid sump of 10,000 gallons capacity would collect regeneration liquors and effluent of high ionic load to be dealt with in the conventional treatment unit. Here final disposal would be effected, after reducing hexavalent chromium with sulphur dioxide, neutralization and precipitation with lime slurry at controlled *p*H and clarification by settlement in a large circular concrete pit holding approximately 10,000 gallons. The sludge resulting from the process would be withdrawn from the bottom of the tank by hydrostatic head through a pipe leading to a sludge sump for subsequent removal.

Provision would also be made for the disposal of cyanide-containing solutions by chlorine oxidation in alkaline solution.

The author then gives more precise details of the plant installed including details of the regeneration technique. Some of the main problems encountered when the plant was first run are also given.

The main problem was the frequency of regeneration which was necessary to a much greater extent than was anticipated. The cycle time was occasionally reduced to as short a period as two hours. This resulted in the production of a very large volume of regeneration liquor, with which the disposal plant could not cope. One regeneration might well give 5,000 gallons in the sump, this having a capacity of only 10,000 gallons, and for various reasons the disposal plant was not

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R. Fairfax-Naylor (Precious Metal Depositors Ltd.), Dr. A. Kellner (Lea Manufactuaing Co., U.S.A.), and E. F. Marlow (Precious Metal Depositors Ltd.).

working at full efficiency. This sump could not therefore be cleared for further regenerations, so the plant had to be shut down at intervals to clear the sump. Furthermore, a regeneration itself took about two hours to complete and at times therefore one regeneration was hardly completed before another was required.

Following experimental work the basic change of the plant was the addition of two new cation exchange towers introduced between the filters and the existing beds. The new towers contained only Zeo-carb 225 to remove the bulk of the cations. It was intended to regenerate these beds with approximately 8 per cent H_2SO_4 prepared in the tank previously used to recover acid in the first scheme. In order to increase the capacity of the system for anions some of the Zeo-carb 225 in the mixed beds were replaced with new Deacidite FF. The author did not know the figures for certain, but approximately 250 cu. ft. of mixed resin in the first place two-thirds were Deacidite FF, *i.e.* about 170 cu. ft. and about 85 cu. ft. Zeo-carb 225. This was done in order to retain the mixed bed feature, which is known to produce better water than that produced by separate anion and cation columns. At the same time regeneration techniques were altered the 225 being now regenerated with 350 gallons of approximately 5 per cent H_2SO_4 and the FF with 260 lb. NaOH in 400 gallons. No soda or acid being recovered. The rinsing techniques were not basically changed, except that rinsing was continued until the stream was substantially colourless.

The author then gives an estimate of the costs involved in running the plant and the alternatives to it.

DISCUSSION

Mr. W. G. L. Miller (Ford Motor Co. Ltd.) said that both demineralization and effluent treatment had been dealt with in the paper. They had the common purpose of removal of constituents deleterious to the next use of the water, and contributed to the better use of the country's dwindling water supplies. For far too long industry had squandered these, and had endangered natural underground supplies by increasing withdrawals without regard to replenishment.

The ion-exchange treatment required made a tangible contribution to the solution of the problem, and one could only hope that the added inducement of cost reduction in certain circumstances would cause others to adopt similar systems. He felt bound to express some envy of the authors in having a local authority which permitted discharges containing 5 parts per million of copper and cyanide, and 7 parts per million of chromium. Perhaps, too, they were a little ungenerous in describing the permitted 1000 per cent. increase in impurity as a "slight" relaxation of requirements.

Demineralization, by permitting the re-use of water after purification, could reduce the water demand by as much as 90 per cent but did not in any way reduce the total quantity of toxic materials in the combined discharges from the plating shop, and this perhaps might be emphasized more strongly. The resultant lower volume of total discharge mainly required a correspondingly more efficient effluent treatment, planned to meet local requirements of the order of 1 p.p.m. in respect of other toxic metals. In view of the teething troubles experienced with effluent, emphasis should be placed on the need for a sufficiently large plant

to handle it all. Their own plant had had trouble attributed, for example, to addition agents in the bright copper. The addition of carbon to filtration had cured the problem.

Was the need for caustic discharge, to raise the *p*H of the demineralized water, specifically connected with chromium plating troubles and what were the ill effects produced? Was the effluent plant consultant-designed, or was it supplied as a complete proprietary unit?

Mr. E. A. Ollard (Atlas Plating Works Ltd.) said effluent treatment was essentially a local matter. The plant with which he was concerned was in London where conditions were different from almost anywhere else, and certainly those described in the paper. The factory's effluent was only a very small proportion of the total London sewage. It had to travel quite a long way to reach the sewage-disposal plant and by the time it arrived many things were not important. However, the L.C.C. was very concerned that poisonous or irritant gases should not be released in the sewer and it was possible that one organization could put down cyanide, and another acid, producing a gas which could have fatal results for anyone walking down the sewer.

An appreciable percentage of cyanide was, however, permitted, and the specifications that the L.C.C. would accept were published in the annual report of the scientific advisor to the council's Public Health Department (No. 4102).

In their own case cyanide had been the principal trouble. Their plant had been designed by an outside body but there was no intention of trying to reclaim the water in the factory as this would have been too expensive and would probably have involved a larger plant.

It was necessary to segregate the various swills from the processes. This was quite a problem in a building which was already loaded to capacity. It had been achieved by putting in a double layer drain. One of the difficulties in disposing of cyanide was the presence of nickel. The nickel became apparent in the test applied by the authorities and was extremely difficult to break down. Also cyanic chloride, though it did not show up, upset people working in the sewers.

Mr. S. A. Benn (The Permutit Co. Ltd.) said that his company had installed the plant referred to in the paper, the first of its kind. Its object was to recover some 7,500 gallons of water an hour of swill continuously, as this constituted an acute embarrassment to the sewage authorities by reason of the volume.

In the initial installation they had been horrified to see that the plating shop was extremely old-fashioned. This necessitated removing foreign matter ahead of the ion exchanger. It was decided that they would, as was necessary, separate the cyanides. They had taken the whole swill and passed it to an ion filter plant for complete demineralization on a re-cycle basis. The ion-exchange plant had to be regenerated from time to time. The concentrated reject from that plant went to a neutralizing plant and was continually neutralized in the conventional way. The same plant was used to neutralize bulk discharges at weekends.

During the initial operation of the plant certain difficulties were faced. They had been getting down the drain strong acid shots which should not have happened, and this was eventually overcome. Another problem was the fact that at one time they were treating a water supply which was not the Oxford town supply but one highly organically polluted. There had also been trouble with the precipitation of metals on the anion resin mixed bed units. To overcome this installation was effected, free of cost to the client, of two cation units which acted as scavengers.

Mr. Benn said that the figures given for amortization of the plant were not realistic. He submitted that the figure of 9/3 per 1000 gallons for the cost of the recirculating and disposal plants should more properly be 7/6; and the figure of 3/6½ for a possible conventional disposal-only scheme should be about 7/-. Instead of 5/5½ for deionized water, itself a very conservative figure, one then had the figure of about 3/-, representing the cost of getting deionized water on a full recovery basis and making the industry more or less independent of external water supplies.

Difficulties with Shut-downs

Dr. V. E. Gripp (The Permutit Co. Ltd.), referring to the difficulties associated with shut-downs, which had been mentioned in the paper, said that the shut-down period, though obviously an embarrassment was not very extensive. During it the chemists concerned had had to undertake tasks of some magnitude, bearing in mind that this was the first plant in the country—perhaps in Europe—which was treating plating swill water by an ion-exchange process. They had had very short "runs" and even when they had eliminated the strong solutions being dumped for treatment they had found that the resins did not work. From tests on site and in the laboratories in London they had come to the conclusion that the exchange materials had been poisoned. This led to an examination of the content of the resins and considerable quantities of complexed cyanides and other organic materials had been found which were not readily removed by the regeneration technique.

After a further passage of time and a considerable amount of investigation, a chemical process had been worked out for reactivating the resins, removing the complexed cyanides, the additives of

nickel etc., so that the original exchange capacity could be restored. This they had been able to achieve on the planned scale and the plant had gone into operation during the summer of 1958. He understood that it was still working with the original charge of resins, which had subsequently been depoisoned. For this purpose they had not used the standard anion exchange material but had drawn a rather unusual material from their production—with a somewhat different amount of cross-linking so that it could better resist the poisoning characteristics. Subsequently they had gone further in this field and the results obtained with the plant had been well substantiated in other large establishments.

MR. J. CHADWICK (Joseph Lucas Ltd.), referring to the statement that recirculated water with a conductivity as low as 1×10^{-6} mhos had been obtained, asked whether this purity had been maintained in practice over long periods? Could details be given of the various rinse waters before purification and how much water was added to compensate for losses in recirculation?

Contamination by Heavy Metals

MR. G. GRIFFITHS (Triumph Engineering Co. Ltd.) asked whether the contamination by heavy metals had not been expected. Would the authors indicate which anions and cations were expected to be removed on a mixed resin bed of the kind described? It appeared that the original scheme for separating the weakly contaminated wash waters from any occasional heavily loaded liquors by conductivity cell and valves had now been abandoned. Did this mean that all the effluent now passed through the ion-exchange resins, or had some other method of protecting the resins from exposure to this occasional heavy contamination been introduced?

He was not sure which parts of the scheme were operated on a batch process and which were continuously flowing and he would like clarification on this.

DR. D. N. LAYTON (Ionic Plating Co. Ltd.), felt that the type of plant under discussion would come into greater use during the next few years in plating shops. The paper brought home the cost of dealing with effluents in this way. However much one might argue about amortization the fact remained that it was a fairly expensive business.

Surely the first thing to do about effluent was to reduce it as much as possible in both volume and degree of contamination by the use of commonsense, contraflow principles etc. People might think that it was difficult to work out the mathematics but it was not, provided one did not deal with differential equations to calculate build-up of contamination with time.

If one took steady-state conditions, assuming that the plant was running at full production and had been for a sufficient number of months, it was possible to study the concentration under average operation, and it was only necessary to set up a series of linear simultaneous equations such as were quite easily solved.

Author's Reply

MR. G. G. PARKER (Morris Motors Radiators Branch), replying, said that the need for caustic soda dosing had been partly brought about by the thought that there might be staining, but mainly because they had expected corrosion from brass taps etc. In point of fact, when the caustic soda had broken down this had proved to be no trouble. The plant had been consultant designed.

He felt that Mr. Benn had given a somewhat coloured account of the happenings in the plant. However, it was somewhat unfair to say that the plating shop was extremely old fashioned. The reference to strong acid being discharged frequently and causing trouble prompted him to say that it was really partly due to the conductivity cell in the effluent being much too sensitive. While there was acid coming down at certain times it was not so strong as would seem from the reaction of the cell. Only a very small part of the effluent was in the category said to be highly contaminated with organic material. There was an artificial pool from which water was drawn for certain purposes, but it was used in only a very small part of the plating shop and he did not think that it constitured a great problem.

So far as the figures on the cost of the plant were concerned, he thought these were reasonable, as were those for amortization. It was obviously a fairly expensive undertaking. There were no figures on the conductivity of the recirculated swill water at the moment yet it was certainly better than ordinary distilled water. Some 250 gallons of water an hour were added to compensate for losses in recirculation and the contamination by heavy metals of the anion resin was confirmed as being nickel ion.

The treatment of the ordinary swill water was clearly a continuous process, but some batch treatment was carried out, perhaps once a fortnight. This had been reasonably satisfactory. Strong acid solutions, soda rinses etc., were also treated in this way. A conductivity cell placed in an appendix to the main flow to control influent waste water had proved very inefficient and this was unfortunate as it was in a key position and would have relieved part of the problem if operating satisfactorily. With the greatest of care nickel solutions occasionally leaked, producing quite high loads, which were not always detected in time.

FINISHING NEWS REVIEW

B.N.F.M.R.A.

Some Extracts from the Annual Report, 1960

PROGRESS on more than sixty major researches designed to improve the quality, durability, reliability and performance of non-ferrous metals and their alloys was reported by the British Non-Ferrous Metals Research Association at its forty-first annual general meeting.

Two trends are notable in the annual report : First, side by side with its fundamental research, more attention is being given to development work and short-term specific researches with a view to passing on results as quickly as possible to industry. Second, there is increasing activity among the primary producers to promote international research into further applications for non-ferrous metals and their alloys ; the trend to international co-operation in research on copper, cobalt and zinc has led to the placing of contracts with the B.N.F.

Protective Coatings

Hot-dipped galvanized coatings have been studied on steel tanks requiring protection in hot-water systems, and on structural steel for exposure to the atmosphere. Pilot-scale tanks galvanized in zinc-aluminium baths have remained unpitted for well over a year both in an aggressive natural water and in London water from which organic material encouraging the formation of a protective scale has been removed ; conventionally galvanized steel pitted rapidly in both tests. Even a nodular scale, given sufficient time, would eventually form a protective blanket in these waters, and the additional margin of safety provided by the improved coating would probably be sufficient to protect the comparatively small proportion of tanks which fail prematurely. However, more work is required to find a method of consistently applying such coatings without blemish to large areas of steel.

Coatings in excess of 3 oz. per sq. ft., required for protection of structural steel exposed to certain atmospheres, may be applied by raising the galvanizing temperature or by using certain alloy steels for the work, but there are objections in practice to both methods. Work during the past year has confirmed that such coatings may be produced on mild steel by prior surface treatment. Research on both aspects of galvanizing has been hindered by lack of knowledge about the basic factors controlling the growth of alloy layers, and a new research to remedy this was started late in 1960.

Investigations have also been made of coatings for the protection of aluminium alloys, applied by anodizing or spraying. Information on an abrasion test suitable for quality control of anodized coatings was released to members this year and in other work the validity of various accelerated corrosion tests for anodized aluminium is being examined. Sprayed coatings on aluminium alloys have continued to provide protection against corrosion under a wide range of conditions, and the most recent tests have confirmed their value in the protection of high-strength alloys against stress-corrosion under stresses in the short transverse direction.

Electroplating

The major effort in the electroplating researches has again been devoted to improving the durability of chromium plating. A co-operative investigation with members, in which the validity of several accelerated corrosion tests has been checked by comparison with the effects of atmospheric exposure in duplicate articles, is now nearing completion. Information on such tests is particularly desirable, as they are used not only for quality control and inspection but also as checks in the development of improved coating systems. Other work has confirmed that there is a progressive improvement in corrosion-resistance with increasing thickness of chromium to 0.05 thou. or more, and has shown that there is little difference in corrosion-resistance between the coatings deposited from the several types of bath in which thicker chromium can be plated free from cracks. Variability in the performance of thick chromium deposits in some of these tests and elsewhere, possibly associated with variations in the undercoats or basis metal, led to a new investigation of the factors causing porosity in chromium plating. Preliminary work has shown that a quick electrographic test, which was claimed to detect porosity present immediately after plating, is not satisfactory, and in present experiments the results are being checked by accelerated corrosion tests either in the laboratory or in the atmosphere at Euston Street.

Duplex nickel deposits under conventional or thick chromium have also been studied. There have been major differences between the results obtained by various workers on duplex nickel coatings. It may be that the performance of coatings of this type varies either with the nature of the environment or the composition of the individual nickel layers—factors which have still to be investigated.

The incorporation in nickel deposits of organic additives to the bath is the subject of a fundamental research making use of radioactive-labelled compounds. This has now provided some understanding of the influence of variations in plating conditions on the incorporation of such organic matter, on the formation of adsorbed films on metallic surfaces (which may affect the properties of subsequent deposits) and on the decomposition of organic additives which leads to the build-up of harmful products in the bath.

Finishing Companies Merge Interests

R. CRUICKSHANK Ltd., of Camden Street, Birmingham, 1, industrial chemical manufacturers and suppliers of chemicals and plant used in the electro-plating and metal finishing industries, has now joined the Forestal Group of Companies of The Adelphi, John Adam Street, London, W.C.2. It is intended that the considerable technical resources of Forestal shall be applied to extending the range of products and the level of technical service provided by R. Cruickshank Ltd.

Mr. A. J. L. Nash will continue as managing director and the name of the company will remain unchanged.

NEW CLUB OPENS ITS DOORS

THE "YZ" Club—the only one of its kind in this country—has just enrolled its first two members. The formation of the Club by the Royal Society for the Prevention of Accidents was first announced in October 1960. Its object is to encourage employees to take a greater personal interest in the prevention of industrial accidents, and membership is restricted to industrial workers who, by wearing a safety helmet or hard hat while at work, have saved themselves from serious head injury from falling materials.

In 1959, the last year for which detailed figures are available, 14,547 industrial workers were injured as a result of being struck by falling objects, and 72 of them died. Not all of those 14,547 people received head injuries ; there were, in fact, 9,029 accidents resulting in injuries to the head.

The growth of the Club will be watched with interest, since it will serve to indicate the rate of progress in the campaign to encourage the more extensive use of hard hats. Many firms in a wide variety of industries are already setting a good example, but industrial head injuries will only be reduced when *all* employees who are likely to be exposed to the risk of falling materials have been provided with head protection *and wear it*.

Full details concerning membership of the Club may be obtained from the Industrial Safety Division RoSPA, 75 Victoria Street, London, S.W.1.

Recruitment and Education for the Ceramic Industries

A CONFERENCE on the problems of recruitment and training for the ceramic industries was held recently at the College of Ceramics, North Staffordshire College of Technology, which was attended by about 70 delegates representing all the major sections of the industry.

In summarizing the discussion, the Chairman, Mr. G. N. Hodson, M.B.E., J.P. (President of the Institute of Ceramics, past-president of the British Ceramic Society and chairman of the British Ceramic Council), said that the College was willing to provide a course leading to a Diploma in Technology if there was sufficient support. To test the feelings of the meeting he would move the following resolution : "This Conference recommends that application be made for approval of a course leading to a Dip.Tech." and this resolution was carried without dissent.

PAINT MANUFACTURERS OPEN INDUSTRIAL FINISHES DEMONSTRATION CENTRE

JENSON and Nicholson Ltd., have recently made considerable extensions to the Industrial Finishes Demonstration Centre in their factory at Stratford, London, E.15, and it is now possibly one of the best-equipped centres of this kind in the country.

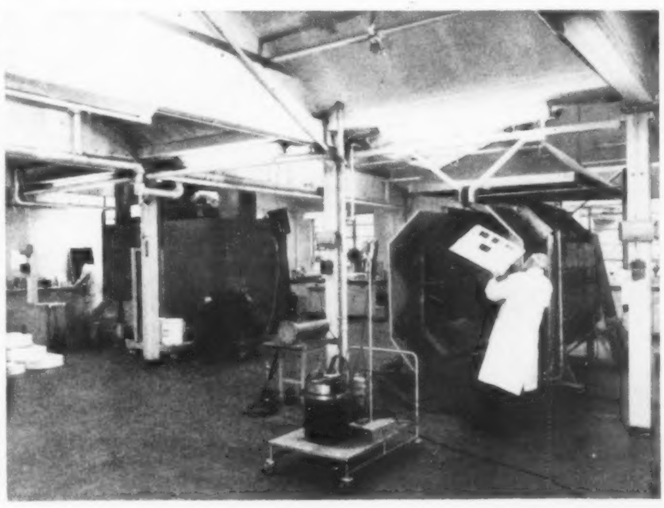
Included in the new equipment is an electrostatic plant of the kind used in many factories today. At the Centre, finishes are applied and tested on the customer's own articles, in conditions approximating to those on the actual production line. The correct methods of application of the finishing materials can be demonstrated to the customer's staff who have to do the job. This is important because the finishing of industrial products has become very complex, as not only the finishes themselves, but the application processes, have to be "tailor-made" to suit individual requirements.

In addition to testing the application of finishes, the facilities of the Centre allow for the rapid production of samples of finishes on actual articles, for submission to prospective customers.

Manufacturers are cordially invited to visit the Centre or to submit any problems regarding finishing. Advice will be given free, without obligation.

(*above*) *Panels passing through curtain coating machine.*

(*below*) *Gas-fired radiant heat oven ; indirect gas-fired box oven ; portable compressor ; hot spray plant ; electrostatic hand gun ; a finished panel being inspected after being sprayed and stoved in a radiant heat oven.*



TECHNICAL and INDUSTRIAL APPOINTMENTS

Mr. A. E. C. Hatton has been appointed Export sales manager of **Laporte Chemicals Ltd.**

Before joining the Laporte Group last year Mr. Hatton spent 14 years in the South African chemical industry, first with African Explosive and Chemical Industries Ltd., and later in charge of the Johannesburg office of Alfred Pearson and Co. (Pty.) Ltd.

Mr. L. D. Smith has been appointed Export sales office manager. Mr. Smith has been active in the Junior Chamber of Commerce movement, both nationally and internationally, and has been nominated National Secretary for Great Britain for the coming year.

* * *

Sir Edward Playfair, K.C.B., has been appointed chairman of **International Computers and Tabulators Ltd.,** when he is released from the post of Permanent Secretary to the Ministry of Defence.

Mr. Norman Readman, managing director of the Consolidated Pneumatic Tool Co. Ltd., of 323 Dawes Road, London, S.W.6, has been elected President of the **Chicago Pneumatic Tool Company,** New York, to succeed Mr. Guy J. Coffey.

Mr. Coffey becomes chairman of the board in succession to Mr. H. Arnold Jackson who has retired, although remaining a director and chairman of the Executive Committee.

Mr. Readman, who leaves for New York in September, joined Consolidated Pneumatic in 1943 and was appointed a director in 1947. He became managing director six years later and has been responsible for the development of the company throughout the Western Hemisphere with extensive interests in India, Australia, South Africa and Germany. He was appointed a director of Chicago Pneumatic last year.

The following appointments are announced by **W. Canning and Co. Ltd.:** Mr. F. H. Ewens, F.C.A., has relinquished his joint managing directorship but will continue to be chairman of the board; Mr. W. H. Griffin, J.P. becomes sole managing director and deputy chairman; Mr. L. G. Mummery, F.C.A. has relinquished the office of secretary of the company and becomes assistant managing director; Mr. E. L. Masek is now director responsible for London, Sheffield and Glasgow branches; Mr. B. Tromans, F.R.I.C. is director responsible for the manufacture and control of chemicals, abrasives and polishing materials, and for the technical centre and research laboratories; Mr. D. Paddon-Smith, M.B.E. is now a director in place of Mr. S. Dawson who has retired; Mr. J. M. Stevens, A.C.I.S., has been appointed secretary of the company.

LONG SERVICE PERSONNEL VISIT BASLE

THE illustration shows a party of 30 Geigy long-service employees leaving by air in June to spend a long weekend as guests of the management of the parent company in Basle.

Many employees besides those in this group have completed 25 years' service with Geigy : these are some who happen not to have visited Basle in the regular course of business.

NEW COMPANIES

"Ltd" is understood, also "Private Co." Figures = Capital, Names = Directors, all unless otherwise indicated.

Lamabar, 15 Avenue Parade, Accrington. May 8. £100. To carry on business of manufacturers of and dealers in abrasive and polishing media, etc. Robt. Sutcliffe.

Marine and Industrial Corrosion Control, 11 Percy Park Road, Tynemouth, Northumberland. May 9. £100. Joseph K. Jackson, Clasina M. Danissen.

B.B. Electroplating Co. (Camberwell), 118/120 Ormside Street, S.E. 15. May 10. £6,000. Walter E. Kirsch, Charles L. Garrod.

A.B.G. (Electrodepositors), 2-4 Dingwall Avenue, Croydon. May 11. £1,000. John M. Benfield.

Bilston Enamel Co., 24 Mount Pleasant, Bilston, Staffs. May 12. £100. Albert Biddulph, Mrs. W. M. Biddulph.

Fisher and Abel, 69 River Road, Barking, Essex. May 15. £100. To carry on business of welders, metal finishers, etc. Thomas M. Fisher, Roy F. Abel, Emily Fisher, Mrs. Doria E. Abel.

M.S. (Electro-Plating), 713 Imperial House, Kingsway, W.C.2. June 2. £100. Montague Smith, Harry Portugal.

C. T. Digby and Sons, Nicol Road, Chalfont St. Peter, Bucks. June 5. £100. To undertake welding and metal fabrications, metal machinery, metal and paint spraying, etc. Charles T. Digby, Kathleen P. E. Digby.

From the Register compiled by Jordan & Sons Ltd. 16 Chancery Lane, London, W.C2.

FIRST DEMONSTRATION OF NEW POWDER PISTOL

The Berk 61 *powder pistol being demonstated.*

FORTY-TWO representatives from twenty-three North Eastern companies recently watched a demonstration of the new Berk 61 metal spraying pistol at the Middlesbrough works of Dorman Long (Bridge and Engineering) Co. Ltd. The demonstration was organized by the Coating Division of F. W. Berk and Co. Ltd., who have developed the Model 61 pistol to meet the needs of contractors who require fast spraying equipment.

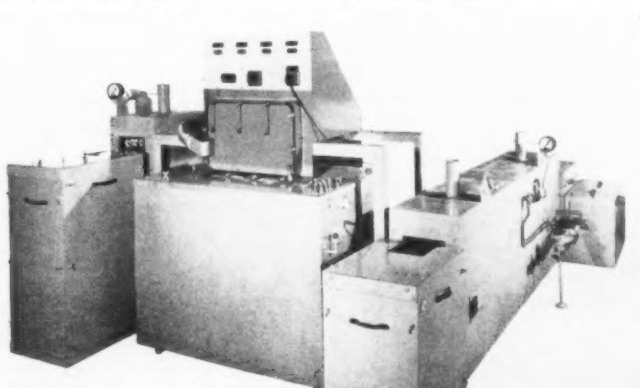
The Berk 61 pistol will deposit zinc powder with a deposition efficiency as high as that obtained with a 35 p.p.h. pistol, with the same gas and air consumption, but at a rate of 110 lb. per hour. This is approximately equivalent to the deposition of 0.004-in. coating over 650 sq. ft. per hour. This performance is achieved by means of the patented nozzle, which projects powder, gas and air through alternate and concentric jets. This nozzle, which can be cheaply and easily replaced, is the only part of the pistol which can require maintenance. As the pistol is intended for large scale spraying, it is correspondingly light, well balanced and easy to handle.

Other equipment shown at the demonstration included the Berk Model 50 pistol, used as a pacemaker to the Model 61, the Berk 58 wire gun, and Berk grit-blasting units. A new development is the "Slim Jim" grit-blasting machine, which has been designed for lowering through small (18 in.) manholes where the internal surfaces of tanks are to be blasted.

After a luncheon at the Highfield Hotel, Middlesbrough, a lively discussion under the chairmanship of Mr. F. A. Rivett, a director of F. W. Berk and chairman of the Coating Division, ranged widely over the whole subject of powder and wire spraying.

SPECIAL-PURPOSE PLANT FOR DIP COATING

THE semi-automatic plant illustrated was specially developed by Lionel Hook and Sons Ltd., for applying a decorative and functional plastic finish to a range of hooks by the new "fluidised" powder technique. The plant, now installed at the Birmingham works of Guest, Keen and Nettlefold (Midlands) Ltd., is the forerunner of a general purpose unit now being developed by Lionel Hook for a variety of similar work with thermoplastic powders.



VITREOUS ENAMELLERS JOIN PROMOTION COUNCIL

THE Vitreous Enamellers' Association, for 25 years the industry's trade association, has joined forces with the Vitreous Enamel Development Council, the industry's promotional body. Its members, in the Association's new role, will form a Jobbing, Signs and General Division of the Council.

This brings the number of the V.E.D.C.'s Divisions up to five, the others being Architectural, Hollow-ware, Aluminium, and Frit and Raw Materials, and its membership to over 60 companies.

In order to make possible the fusion of the two organizations, the V.E.D.C. altered its constitution to admit corporate bodies as members.

The Jobbing, Signs and General Division will shortly set about planning a promotional programme. Its secretary is Mr. C. Hardeman Smith, secretary of the V.E.A., 96 Hagley Road, Edgbaston, Birmingham, 16. Correspondence on promotional matters should be addressed to Commander Geoffrey Clarke, general manager of the V.E.D.C., 28, Welbeck Street, London, W.1.

Trade and Technical Publications

Two technical leaflets have been received from Robinson Brothers Ltd., Ryders Green, West Bromwich, dealing with tribenzylamine and ethylene thiourea.

Tribenzylamine is water-insoluble, with a hydrochloride which is almost water-insoluble, and should be of interest as an amine catalyst in organic synthesis, in the liquid/liquid method of separation of metals, as an iron pickling inhibitor and as a constituent of copper-on-iron plating.

Ethylene thiourea is an accelerator for neoprene, and is also of interest as an anti-corrosion agent for ferrous metals against acids and non-ferrous metals against alkaline detergents.

* * *

The second edition of the English Lea Manual, published by The Lea Manufacturing Co. of England Ltd., P.O. Box 1, Buxton, is now available and can be obtained from the above address on request from the trade or from technical students. The products referred to in the manual emphasize the trend towards automation in the metal finishing industry and the range of Liquabrades and Learoks now being made in this country has been considerably augmented.

Other products now available in the U.K. are Plasti-Brade, Plasti-Glue, Gripmaster, Lubar and Liqualube. Full details of these and other products, with information on typical installations using the Lea method are included.

* * *

A comprehensive well-illustrated brochure describing their various types of automatic electroplating plant has been published by W. Canning and Co. Ltd., Birmingham, 18. The range of Canning plants, it is pointed out, is not limited to the very large user, and it is suggested that any firm operating three or more 6 ft. x 3 ft. nickel vats to full capacity might well find an automatic plant to be an economic proposition.

Also published by the company is a supplement to the "Canning Handbook on Electroplating" which gives details of recent developments and modifications in processes and techniques. This supplement is available free of charge, to those who have the 19th Edition of the Canning Handbook, and copies are being sent direct to all known users.

In connection with the reference in the supplement to duplex nickel plating it should be mentioned that the information given in News Sheet 15A, supersedes that appearing on pages 641 and 642.

As the 19th Edition of the Handbook has met with unprecedented demand both at home and overseas and the initial printing is now exhausted, the company have reprinted the Handbook incorporating the supplement and including footnotes in the reprint section indicating where supplementary information is given.

The introductory matter of the Handbook has also been re-arranged to include a list of previous editions dating back to the original publication in 1889.

The price of the Handbook remains at 30s. post paid.

* * *

A leaflet from Byron Botterill and Co. Ltd., Rockingham Street, Sheffield, 1, refers to the Gutex rubber-bonded polishing and contact wheel which is now available in the United Kingdom and Eire ; the company are distributors for this area. The wheel is made in Sweden, and is claimed to have long life, controlled flexibility, longer head retention, oil resistance, etc. and is recommended for use with the Lea products such as Plasti-Brade, Gripmaster, etc.

* * *

Industrial maintenance coatings are the subject of a new booklet published by Camrex Paints Ltd., Hudson Road, Sunderland, and available to those interested on request. Full details are given of surface preparation, process, special process, wood primers, undercoats, finishing coats and special coatings, *i.e.*, those based on synthetic resins. The company also offer the services of their technical advisory department and a colour advisory service.

* * *

The Cambridge Instrument Companys list 143/1 describes their recording counters which record the frequency, clock time, and duration of industrial processes or machine operations. The circular charts on which this information is traced also indicate, by default, periods when the machine or process is shut off. Cambridge recording counters are used in industrial processes as varied as mining and baking, with all kinds of plant from furnaces to refrigerators and in conjunction with all types of machinery from pumps to lathes.

A very wide range is manufactured to allow the best possible choice for any one application. Single- or multi-pen recorders operated by either mains or battery are available and combined counters and temperature or pressure recorders can be supplied. List 143/1 can be obtained from the company at 13 Grosvenor Place, London, S.W.1.

* * *

From The Meaker Co., a subsidiary of Sel-Rex Corporation, Nutley 10, New Jersey, U.S.A. a comprehensive illustrated booklet describes their automatic and semi-automatic electroplating and metal finishing machines. Following an opening chapter entitled "Designing for Automation," information is given on the company's "Straight-A-Way" return-type full automatic, return-type "Uniline" and "Little Giant Utility" electroplating machines. Barrel plating machines are also dealt with. The booklet continues with details of anodizing equipment, scrubbing machines for strip, pickling equipment, galvanizing installations for steel strip and wire, and electrolytic cleaning lines for strip.

* * *

A revised, simplified edition of the long-established B.S.443, "Galvanized coatings on wire," which lays down requirements and tests for weight, uniformity and adhesion of zinc coating has just been published.

The size range for galvanized wire has been extended : the maximum diameter is now 0.400 in. and the minimum, 0.009 in.

The volumetric method is introduced as an alternative to the gravimetric method for determining the weight of zinc coating where the nominal method for determining nominal diameter of the coated wire is not more than 0.195 in. This method is quicker than the gravimetric but the latter is to be used as the referee method in case of dispute.

The copper sulphate (Preece) dip method for determining the uniformity of coating is still given but the standard no longer requires the wire to be bent round a mandrel before the dip test.

Useful formulae are included in 11 pages of appendices.

Copies of the standard may be obtained from the British Standards Institution, Sales Branch, 2 Park Street, London, W.1., price 6s. 0d. (Postage will be charged extra to non-subscribers).

Latest Developments in PLANT, PROCESSES AND EQUIPMENT

Infra-red Curing of Synthetic Adhesives

USE of synthetic adhesive applied metal-to-metal, now being employed in place of rivets in the manufacture of artificial limbs, has been made economically possible by a special infra-red curing oven supplied by George Vokes (Infra Red) Ltd., High Road, New Southgate, London, N.11.

The manufacturers state that in the design of this oven they have opened up a very wide field of curing synthetic resin adhesives on a flow-line basis, and they already have several alternative designs available.

It has been established that Araldite Grade 1, cured by radiation at 200°C. for 40 minutes, produces a bond stronger than the traditional rivets, which have been found occasionally to loosen and creak with the action of walking.

The oven (Fig. 1) was designed for a throughput of 25 to 30 limb-components per hour, and is capable of resin bonding components at both ends of a shin-piece, simultaneously. It will also accept thigh-sockets and other component parts without adjustment of the plant, and was supplied to the order of J. E. Hanger and Co. Ltd.,the largest manufacturers of artificial legs in the world.

The parts to be cured are suspended from a slow-moving conveyor arranged to take the various shapes and sizes on supporting hooks at intervals.

Using the Vokes metal-sheathed elements, the infra-red projectors are positioned at sides and bottom of the oven, and are capable of being switched to either location for the purpose of economizing electric power.

Oscillating Hotplate

THE simultaneous heating and stirring of liquids at a constant temperature for analytical and preparative work in industrial, educational and medical research and control laboratories can now be achieved quickly by the use of the oscillating hotplate marketed by the Griffin and George Group, Ealing Road, Alperton, Middlesex.

The hotplate accommodates twenty-eight 250 ml. or eighteen 400 ml. Griffin beakers, and oscillates in a circular orbit of $\frac{1}{8}$-in., 216 times a minute, an amplitude and frequency of motion which are optimum for general use. Powdered solids can be prevented from settling and dissolve more rapidly in solvents, while immiscible liquids are kept in intimate contact with each other and can react at a reasonable speed. The makers say

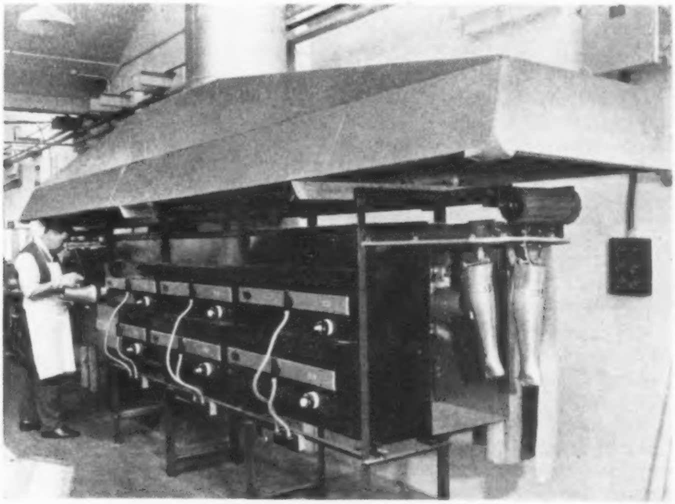


Fig. 1. Infra-red curing oven.

that spattering is eliminated in the evaporation of neutral and acid solutions, and partially with alkaline solutions; digestions and precipitations are accelerated and precipitates are improved.

The heating is governed by a Simmerstat regulator which permits a range of hotplate surface temperatures suitable for most heating operations in general analysis up to a temperature of 650°F. (350°C.).

In metallurgical laboratories the hotplates' oscillatory motion keeps the sample chips bared to acid for the analysis of high-alloy steels such as titanium, niobium, vanadium and tungsten. It is also effective in determining amounts of tin in copper and brasses where the metal is dissolved in acid and the liquid is evaporated.

The hotplate is heated by two steel-sheathed heating elements cast in the shape of an extended S. This construction results in an even temperature over the complete plate surface.

The oscillator is driven by a gear reduced motor with tropicalized winding and an eccentric driving shaft for moving the hotplate. The motor is set in a cast-iron base and stands on rubber feet. The weight of the base and the friction between the rubber feet and the bench top prevents creeping.

The hotplate rating is 2,000 watts at 240 volts.

Ebonite Domestic Water Meter

GEORGE Kent Ltd., Luton, Beds., have announced an Ebonite working chamber version of the brass ½-in. JSM domestic water meter.

The new meter, known as the Kent ½-in. SM, incorporates all the features of the JSM improved rotary-piston-type meter and may be used where the water supply tends to be corrosive. Both piston and working chamber are of Ebonite and will provide long life, without loss of performance or accuracy. It is expected that ¾ in. and 1 in. versions will be introduced later.

All international standard body lengths and end-threads can be accommodated. Registration may be in gallons or cubic metres.

The SM and JSM meters incorporate the following design points :

One simplified counter and reduction gear unit, fully sealed and glandless, replaces the conventional counter mechanism, under-gear and joint plate with gland. All counter parts run in a clear, corrosion inhibiting lubricant maintained at the internal pressure of the meter by means of a compensating membrane.

All gears are in moulded graphited nylon, having a low water absorption characteristic.

The meter has been so simplified that only two screwed threads are used in its construction, with consequent ease of servicing and negligible maintenance costs.

Water flow through the meter undergoes six fewer changes in direction—resulting in a compact meter with maximum capacity.

The SM meter is approximately half the bulk and weight of comparable ½ in. meters.

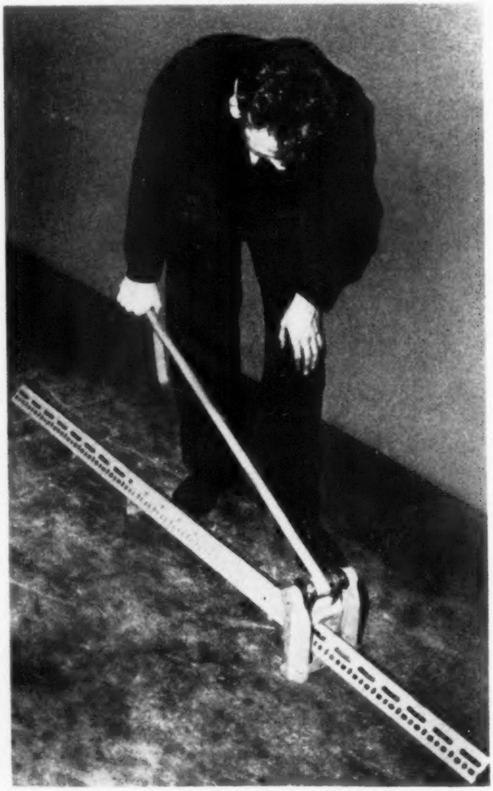
Cutter for Slotted Angle

DEXION Ltd., Maygrove Road, London, N.W.6 manufacturers of the Dexion system of slotted angles, announce the Mark V Cutter (Fig. 2), a significant improvement on the most important accessory in the Dexion range.

This cutter requires no assembly—it can be used straight from its container, on bench or floor—and is readily portable. The erection of all Dexion structures is therefore simplified even further. Cutting is a matter of feeding in the Dexion angle and pressing down the handle. The cutter works on the guillotine principle, giving longer blade life and enabling diagonals to be cut even more easily than before. By using this tool rather than a hacksaw, a clean cut is achieved every time.

(*Continued in page* 286)

Fig. 2.—Cutter for slotted angle




Whichever way you look at it . . .
it's better for being BONDERIZED
672 MPA
"Bonderizing" gives that extra value — now to the brilliant new Ford Consul Classic. Paint is keyed more strongly to the metal surface, corrosion at damaged or scratched areas remains localized and protection is increased. These factors help to ensure that a first class finish is produced — and maintained. That is why the bulk of Britain's motor car manufacturers insist upon
BONDERIZING
The processes for bonding paint to metal surfaces
THE PYRENE COMPANY LIMITED—METAL FINISHING DIVISION
GREAT WEST ROAD · BRENTFORD · MIDDX. Telephone: Isleworth 4131

Preparations for Shot-blasted Surfaces

CAMREX Paints Ltd., Camrex House, Hudson Road, Sunderland, have recently introduced two new coatings—Camrex Shot Prime and Camrex Shot Kote. Both of these preparations are for application over newly shot-blasted iron and steel surfaces.

Shot Prime and Shot Kote have been developed for spray application. It is, therefore, possible to shot-blast very large areas without interruption, dust down and apply a spray coat. Both preparations dry within three minutes and present a surface which, it is claimed, will not corrode for a considerable period.

For example, the surface so prepared is claimed to be resistant to rust for approximately 12 months and is capable of receiving any type of paint, and adhesion to the surface is excellent.

The covering capacity of Shot Prime and Shot Kote is approximately 60 sq. yd. per gal. with a film thickness of 1 to 1½ thou. The finish is aluminium and the material is non-toxic. Plates treated with these materials may be welded without any trouble and both materials have been tested by various shipyards for this characteristic. In addition, welding on one side of the plate does not affect the protective quality of the Shot Prime on the other side, if both sides have been shot-blasted and treated. No toxic fumes are evolved on welding.

Although these materials may be overcoated by all types of paint without any fear of blistering or other faults, Shot Kote is recommended for application when the plate treated will eventually be in contact with oil or solvents.

Shot Prime is recommended as a general-purpose primer, since it is the more economical. Shot Kote has the advantage of being more resistant to oils and strong solvents and has been particularly developed for use on oil tankers and storage installations.

Armour Coating

TOUGH, armour-like coatings — their applications ranging from automobile bumpers to sensitive recording tapes — have been developed from a new family to polyester resins. The Goodyear Tyre and Rubber Company's Chemical Division claim the coatings have exceptional resistance to abrasion, ultra-violet rays, chemicals and weather. Other advantages of the new VPE200 resins include excellent adhesion, clarity, electrical properties and the ability to bind pigment.

The applications are as clear, tinted or coloured coatings for metals and such automotive hardware as bumpers and wheel covers. Other important uses will be as protective and decorative coatings for architectural aluminium and aluminium foil, and in wood stains, toners, primers and finishes. It is believed also that the resins will be useful in hot melt adhesives and coatings.

The coatings may be applied by spraying, dipping, roller coating, brushing, hot melt, knife coating and most other methods of commercial importance.

The new coating resins mark Goodyear's third entry into the field of polyester materials. The others are a polyester laminating film and a polyester resin for synthetic textile fibres.

Additional details and relevant information may be obtained from Hubron Sales Ltd., Failsworth, Manchester, who are the exclusive distributors in the U.K. for Goodyear chemicals.

Small Machine for Electronics Precious Metal Plating

A COMPACT plating unit measuring only 30 in. x 26 in. x 18 in. to the work top contains all the equipment and features for precision-plating of jewellery, electronic parts, specification precious metal plating, or " pilot plant " set-ups, according to an announcement from The Meaker Company, subsidiary of Sel-Rex Corporation, Nutley 10, New Jersey, U.S.A. A completely re-designed smaller version of this firm's " Jet Plater," the new models are said to permit either barrel or rack plating with any cold alkaline solution, and most acid plating solutions, on a mass-production basis.

The company states the new Junior Jet Platers provide the ideal operation for precision-plating : *i.e.*, a plastic centrifugal pump in conjunction with a vinyl jet orifice manifold at the bottom of the plating tank, causes the plating solution to swirl constantly around the work, assuring smooth, even deposits. In operation, the solution is continuously drawn off from the bottom of the tank, circulated through the pump and built-in filter, and returned to the tank under pressure.

All operations are controlled from a convenient panel board which incorporates dual scale ammeter, powerstat control for rectifier, circuit breakers, and automatic timer which sounds alarm upon completion of the plating cycle.

Surface Active Agents

D. G. Bennett Chemicals have recently introduced two new surface active agents.

Serfal 6639 is a non-ionic wetting agent with very low foaming properties, and Serfal CS.170 a non-ionic emulsifier for wax, olein and mineral oils which is also useful as a detergent in alkaline degreasing baths.

Further information is available from D.G. Bennett Chemicals, 11A St. John's Hill, London, S.W.11.

Classified Advertisements

Prepaid rates: FIFTEEN WORDS for 7s 6d. (minimum charge) and 4d. per word thereafter, or 24s. per inch. Box number 2s. 6d., including postage of replies.

SITUATIONS VACANT

ELECTROCHEMIST PLATER REQUIRED immediately for London Area for pilot plant and service work in connection with precious metals. Excellent prospects for right applicant. Apply Box. No. EP.244.

REPRESENTATIVE calling on Electro Platers and Metal Polishers, required to carry additional line of Products, such as Felt Polishing Bobs, etc. Contact Messrs. Tanners Products Felts Ltd., Champness Chambers, Rochdale, Lancs.

TECHNICAL SALES REPRESENTATIVE

Resulting from continued expansion Associated Chemical Companies (Sales) Limited invite applications for a Chemical Sales Representative for the following position.

REPRESENTATIVE—SPECIALIST IN METAL PLATING AND FINISHING

Applicants *must* posses a technical degree and have sound technical knowledge and if possible experience in selling chemicals in this field. The successful candidate should be in his mid-30's and will require to reside within a 20 miles radius of Birmingham.

The position will command a good commencing salary, provision of a Company car, assistance for home ownership and removal allowances, excellent pension and health schemes.

Applications giving brief details should be sent to :—

The Personnel Manager, Associated Chemical Companies Limited,
Brotherton House, Westgate, Leeds, 1

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